What Is the Future of Inland Water Transportation?—*Part I*

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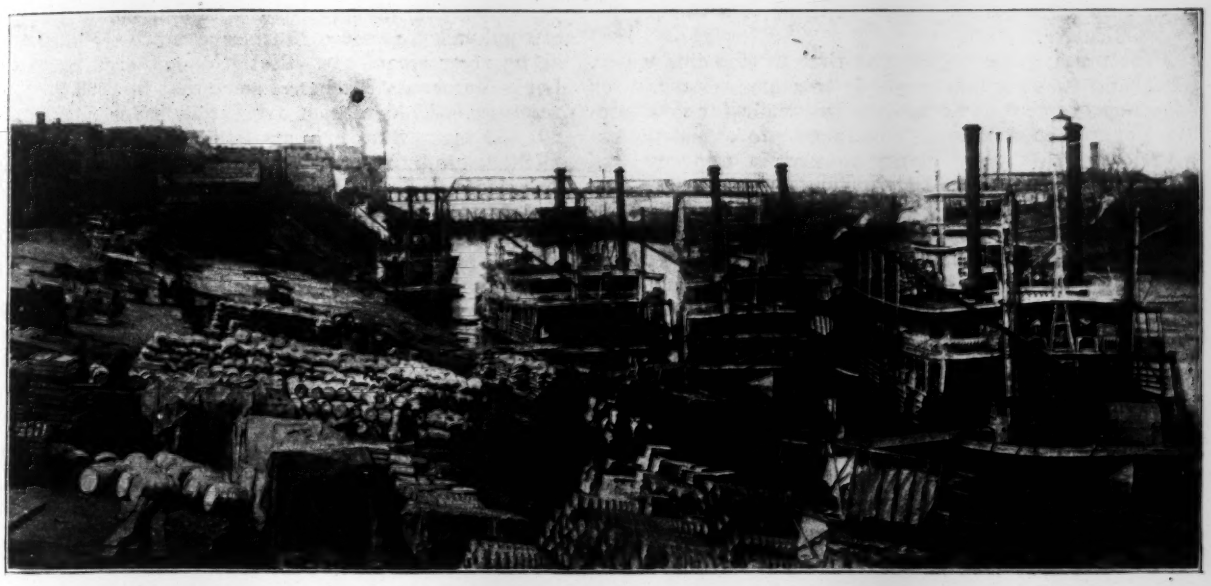

There are here presented the results of a thorough study to determine the present economic position of inland water transportation, the field which it should occupy with relation to railway transport, and the consequent policy which should be adopted by the Government with reference to waterway development.

The investigation shows that traffic on nearly all inland waterways has all but disappeared. With few exceptions, the competition of waterways with railways is no longer of any consequence. The primary cause of the decline of the waterways is the extraordinarily low cost at which the railways of the United States are able to handle low-grade bulk freight, which is the only class of freight on which the waterways can hope to compete with railways.

The widespread belief in the great advantage of waterways, and the stock arguments in their favor, are fairly examined and are found to be based on conditions of the past, not those of the present.

The waterway was the only cheap means of transportaion before the railway came, and the invention of the steamboat multiplied the value of the waterway many times.

It was not until the railway had experienced a half century of development and the invention of the steel rail had made possible the use of heavy rolling stock that low-cost railway transport became possible.

In the battle between rail and water routes during the last quarter of the nineteenth century, public sympathy was strongly enlisted on the side of the waterway because it represented free competition as opposed to monopoly. The belief in the value of potential water competition to keep down railway rates has been almost universal. Government control of the railways has now demonstrated the fallacy of this belief.

The recent great increase in labor costs has hit the water carriers, notably coastwise steamers, much harder than the railways.

The success of water transport on the Great Lakes is shown to be due to conditions which cannot possibly be reproduced elsewhere.

I—Introduction—The Government's Policy Toward Inland Waterways

WHAT is the proper place of the navigable river and the canal in the country's transportation system? Can the steamboat and the barge compete with the railway train? If so, where and under what conditions? Should the United States continue to spend great sums improving rivers for navigation?

These questions are of pressing importance. There is on the one hand widespread belief among business men in the future of water transportation. The Chamber of Commerce of the United States adopted a waterway plank at its annual meeting in St. Louis in April, reading:

"We urge that the Government speedily complete river improvement projects already authorized, and that Congress provide for a comprehensive system of waterways with coördination of the services of waterways and railroads."

On the other hand, the public has become informed as to the practical failure of the Federal waterway improvement program. It is no secret that the annual river and harbor appropriation bill is commonly known as the "pork barrel" bill. Repeatedly on the floor of Congress has the wholesale waste in the Government's river and harbor work been exposed and condemned. Even the Presidential veto has at times been interposed, when the objectionable items in these bills became too scandalous.

The present is an opportune time to stop this waste. Drawing funds from the public treasury ostensibly for the improvement of navigation but really for flood protection, to benefit private interests, or to obtain the expenditure of Federal money in certain Congressional districts, is obtaining money under false pretenses. The nation can no longer afford, with the easy-going indifference of the past, to allow this waste to proceed unchecked. With a vast burden of war debt and huge continuing expenditures to remain long with us as a result of the war, rigid economy in national outlay is imperative.

The United States has spent many millions of dollars on inland rivers, and that, too, within recent years, where no navigation of any consequence now exists. It has built dams and locks on rivers where the only water traffic now is the floating of logs, and these went down stream more readily with the river in its original condition than with the navigation improvements. Surely it is time to stop such waste. Whatever sums the nation is to spend on waterway improvements should be concentrated on channels where the business will be sufficient to warrant the outlay. Scattering Federal money on all sorts of waterway projects, good, bad and indifferent, is an injury to the water transportation interests, not a benefit.

Government Lavish in Its Waterway Work

Waterway advocates have long asserted that the decadence of water transportation is due to the niggardly policy of the Federal Government regarding the inland waterways. How baseless is this assertion may be judged from the fact that the Federal Government has spent to the present time nearly a billion dollars[1] on river and harbor improvement, fully half of which has been devoted to inland waterways. In addition, over $300,000,000 has been spent by the states and by private corporations on inland canal construction. Most of these canals long ago became obsolete and were abandoned, though the one on which over half of the sum was spent, the New York Barge Canal, has only just been completed.

It may be supposed that the above-quoted figures for Government expenditures on waterways represent money spent many years ago, when inland water transportation was in its prime. The fact is, however, that fully half of all that the Federal Government has spent on river and harbor work has been spent within the past 15 years. Even on canals, the State of New York has spent within the past 15 years on its canal system two-thirds as much as all the outlay on all the canals in the United States previous to 1900.

In the face of this lavish expenditure on waterway improvement, inland water transportation has been steadily declining for many years. This is true not only of the smaller navigable streams but of the great rivers, including what was once the most important inland river transportation route in the United States, the Mississippi River.

The river steamboats on the Mississippi reached their climax of prosperity in the '70s. By 1890 the railways had shot so far ahead in the competition that St. Louis, the center of the river-borne commerce of the Mississippi valley, received 15 times as much freight by rail as by river steamboat. Statistics gathered by the St. Louis Merchants' Exchange show that in 1890 St. Louis received 663,730 tons of freight by river and shipped 601,862 tons. Sixteen years later, in 1906, the receipts at St. Louis by river had fallen to 327,670 tons and the shipments to 89,185 tons. During the same period the freight receipts by rail at St. Louis grew from 9,969,000 tons in 1890 to 27,292,000 tons in 1906. The rail shipments from St. Louis increased from 5,270,000 tons in 1890 to 17,672,000 tons in 1906.

Thus, while 30 years ago the receipts of freight by rail at St. Louis were 15 times as great as the receipts by river, a dozen years ago the river receipts had fallen to only 1% of the receipts by rail and the shipments by river were less than 0.50% of the shipments by rail.

There was, however, a widespread belief a dozen years ago that river transportation had reached its lowest ebb and that its revival might be confidently expected. Instead of that, the decline has continued. In 1918 St. Louis received 42,318,000 tons of freight by rail and only 60,450 tons by river. There were shipped out of the city 30,097,000 tons by the railways and 69,045 by the river. Thus, the steamboat commerce of St. Louis in the whole year of 1918 did not equal the railway commerce of half a day.

The few steamboats which still remain on the Mississippi and some of its tributaries are no longer competitors with the railways for through traffic. They are handling a small amount of local business only, on which the boat can for some special reason serve the shipper better than can the railway.

Meanwhile, the United States has gone on with its program of waterway improvement, and has spent money on inland rivers more lavishly during the past dozen years than ever before. The question whether the commerce which will use the improved channel will be sufficient to justify the expense is apparently a purely academic question in which no one in authority takes any interest. When a project is once officially adopted it is carried to completion even though the plans for it become obsolete during the preliminary stages.

The Hennepin Canal

A good illustration of the Government's conduct of its river and harbor work is the once famous Hennepin Canal in northern Illinois. This waterway was originally projected more than half a century ago as a short connection from the upper Illinois River to the Mississippi River. At that time river navigation was still a very active business in the central West. Waterways to compete with railways and cut down railway rates were being actively promoted. Elaborate computations were made to prove the great public benefit which the Hennepin Canal would confer in forcing the reduction of railway rates over a wide territory.

Very likely there was enough foundation for these

[1] The total of all Federal appropriations for river and harbor work, to July 18, 1918, was $971,142,916.

claims, at the time when the project was first agitated, to bring about the exertion of railway influence, then powerful at Washington, to delay action by Congress. At any rate, there was a long period of inaction before the project was formally undertaken. Once started, the work proceeded at the leisurely pace usual on Government works. The river steamboat business, for whose benefit the canal was undertaken, dwindled away, but no one in authority paid any attention to that.

After something like a score of years spent in construction, the canal was opened for business in 1907. It had cost the Government $7,566,000. There has been expended on it since, for maintenance and operation, $1,716,000. The total traffic on the canal for the past five years has averaged only 12,060 tons per annum. Here is a total investment by the Government approximating $10,000,000, plus over $90,000 a year paid out in operating expenses, all to accommodate as much business in an entire year as is carried in a single day over many of the railway lines in the same district. The fourteen locks on the canal must be continuously tended even though the solitude of the lock tenders may be disturbed only once a month by a passing boat.

And yet the case of the Hennepin Canal is not quite so bad as that of some of the other Government works for the benefit of river navigation. At the Hennepin Canal there is at least a lot of well-built masonry structures to serve as a monument for the $10,000,000 expended. There are rivers on which great sums have been spent by the United States, and nothing is left now to show for it. Floods have swept away all vestige of the work done; and the commerce which the work was undertaken to benefit has never materialized.

The public is familiar with charges of gross waste in the conduct of Government business; and the common idea is that the waste is due to dishonesty or inefficiency on the part of Government employees. But the above examples well illustrate the fact that *the chief source of waste in the public business is lack of intelligent planning.* The rank and file of Government employes can carry on routine work very well. They can build a Hennepin Canal when the work is ordered, and make a good job of it. What is lacking is someone with enough intelligence and authority to determine which works are worth while to undertake and which are not, and with the courage, when a mistake has been made, to stop the throwing of good money after bad.

If one inquires the reason why the blind expenditure on waterways has gone on so long almost unquestioned, an answer is found in the fallacious ideas which are so widely held regarding water transportation. A voluminous literature has been circulated for many years, devoted to the advocacy of water transportation. Much of it is the work of writers gifted with enthusiasm but ignorant of the foundation engineering and economic facts respecting modern transportation methods. Many of these writers have been employed to advocate a cause, not to deal with the subject from a professional and unprejudiced point of view.

Practically the whole of this voluminous advocacy of waterways, in books, pamphlets, newspapers and public meetings—and even engineering treatises—rests upon the assumption that water transportation is cheaper than railway transportation. The time has come for an unprejudiced inquiry as to whether this assumption is correct.

II—A Century of Transportation Development

For a clear understanding of the present relations of water and rail transport, nothing can better aid than a brief review of the past century of transportation development. The revolutionary changes in transportation during the past hundred years have transformed the world to a degree that we of the present generation, who have always been accustomed to the conditions created by steam power transport on land and sea, find difficulty in comprehending.

At the beginning of the nineteenth century the art of transportation was in the primitive conditions that had prevailed for ages. The sole power available for land transport was man or animal muscle. On the water this had long been supplemented by one of the great powers of nature, the wind. This was available only for the ocean and other open waters; but inland the rivers were and had been from earliest times the chief highways for freight transport. A horse or man could pull many times as heavy a load on a barge floating on the water as on a cart. Not only such rivers as are now called navigable, but any stream large enough to float a rowboat, was then a better means of freight transport than a road on land.

The Gallatin Report of 1808

The vital importance of economical transportation in advancing the public welfare was fully realized by the statesmen of a century ago. In 1808, Albert Gallatin, secretary of the treasury, made a report on roads and canals which is famous as embodying the first comprehensive plan for carrying out public works by the Federal Government. The Gallatin report made no mention of steam transportation, although an appendix contained a letter from Robert Fulton, who had made his successful voyage with the "Clermont" a year earlier. Gallatin proposed a chain of canals along the Atlantic coast to connect inland tidal waters. Canals across the Appalachian mountains to connect the Atlantic coast rivers with the rivers of the Ohio basin he concluded to be impracticable. Hence he advised that "artificial roads" should be built across these mountains to connect the navigable rivers on each side.

How small and primitive was the water transportation of that day may be realized from Gallatin's references to the few canals then completed. The James River Canal at Richmond could pass boats of eight tons drawing 3 ft. of water. The canals along the Mohawk River were 2½ ft. deep and passed boats of 10 tons. The greatest canal work in the United States was the Middlesex Canal in eastern Massachusetts, connecting the Merrimac river with the harbor of Boston. This canal could pass boats of 24 tons; "but those in most general use are of smaller dimensions and are drawn by two horses at a speed of three miles an hour."

Practically all the work then being done on rivers and canals and on turnpike construction was by incorporated companies, and the financial results were, almost without exception, disappointing. Gallatin recommended that the Federal Government should undertake the construction of canals and highways and the improvement of navigable rivers, covering all the territory embraced in his report. He estimated the total cost at only $20,000,000, and continued:

survival of the fittest, but was due to unfair competition.

"An annual appropriation of $2,000,000 would accomplish all these great objects in 10 years and may, without inconvenience, be supplied in time of peace by the existing revenues and resources of the United States."

Verily, those were the days of small things.

It is difficult to realize fully today what Fulton's invention meant to the world at the beginning of the nineteenth century. The railway was not yet born; good highways were almost unknown. There had never existed in the world such a thing as cheap inland transportation. The population of all civilized countries was therefore concentrated near the seacoast, where water transportation was available. It was impossible to fill with people the great fertile plains in the interior of the continents, such as the valley of the Mississippi, because of the lack of transportation. Although two centuries had passed since the first European colonies were established in what is now the United States, only the region along the Atlantic coast had been occupied.

Crude as were the first steamboats, they were so great an advance over any previous means of inland transport that they were put into use with marvelous rapidity. The rivers had always been the chief arteries of traffic, and now steam power could replace human muscle in the propulsion of boats. For more than twoscore years the steamboat was the prime factor in the development of the Middle West.

The Railway Era

The railway era began in 1825, when George Stephenson's famous locomotive, "Rocket," made its successful trial trip. The river steamboat and the canal boat were then well established. The same year that saw the birth of the railway witnessed also the completion of the Erie Canal by the State of New York. The importance of that waterway at that day in affording a cheap means of transportation between the central West, and the Atlantic coast, by connecting the Great Lakes and the Hudson River, it would be difficult to overestimate.

Stephenson's locomotive was built for high speed, not hauling power. Passenger and express business was the aim of the early railway promoters. They did not expect to compete with the river and canal for freight business; and the early railways were in fact too light and of too small capacity to move freight economically. These early railways were also very costly to construct and to operate. For the light traffic of the pioneer days, the river steamboat, operating on a road which nature had provided without cost, had no fear of railway competition. For the first three decades of the railway era, capital and labor were fully occupied in building railways in the thickly settled Atlantic coast states. The pioneering of the West had to wait.

Those were the halcyon days of the river steamboat. The Mississippi River and all its chief tributaries, where depth of water made navigation at all possible, were traversed by steamboats which were until the Civil War the chief and often the only means of transport. Not till a decade after the war did the decline of the Mississippi steamboat become evident.

In the Eastern states it was found at an early date that the railway had great advantages over the little artificial canals and over navigation on difficult rivers. The abandonment of the early Massachusetts canals followed closely on the coming of the railway. Year by year the railway became a more efficient means of transport; but its period of great development really began when the Bessemer steel rail began to displace the wrought-iron rail. The growth in size of cars and locomotives had been hitherto restricted by the rapid wear of the soft-iron rails. Bessemer's invention made possible that development of the railway as an economical freight carrier that has since taken place.

The Battle Between Rail and Water Routes

Before the coming of the steel rail, the battle between the railway and the steamboat had become active. Public sympathy, at first enthusiastic for the railway, had been enlisted on the side of the steamboat. Those pioneer railway lines were risky ventures, and the men who controlled them sought to make all the profits possible. They charged "what the traffic would bear," and few were prepared to deny their right to do so. The protest against this policy brought about the Granger agitation and legislation of the early '70s, which sought to establish just such control over railway transport and rates as was actually put in force half a century later.

At that time, few public men were bold enough to advocate direct Government control of railways. Sentiment was rather in favor of keeping alive competition, and especially competition by water routes. In 1872 a Senate committee headed by William Windom of Minnesota, who was later Secretary of the Treasury, made a remarkable report on transportation. After recommending legislation for Federal railway control on substantially the lines actually enacted in the first interstate commerce law 15 years later, the committee declared that "water routes when properly located not only afford the cheapest and best known means of transport for all heavy, bulky and cheap commodities, but they are also the natural competitors and most effective regulators of railway transportation."

The committee therefore recommended a system of water routes designed to carry the products of the Central West to the seaboard. Under the conditions then existing the recommendations were justified. At that time the average railway freight on a bushel of wheat from the Mississippi River to New York was 50c. A large part of the corn crop of the Middle West was not marketed because it could not stand the transportation charges. With the equipment and facilities and volume of traffic then prevailing, however, the railways in order to live were compelled to charge rates which today appear high.

Those were the days of sharp competition of railways with one another and of railways and water routes. Rates were made to meet competition as a matter of course. Where water lines were available, rail rates were reduced accordingly. No one questioned the railways' right to do this, any more than they questioned their right to meet the rate of a competing railway. So firmly was this fixed in the rate structure that in the interstate commerce act of 1887 the continuance of special rail rates to meet water competition was specifically authorized.

The period from 1875 to 1900 saw the rapid decline of inland water transportation, except on the Great Lakes. Waterway advocates assert that the driving out of the steamboat by the railway was not a case of the

The railway, even at that day, however, had great advantages over the waterway, apart from the question of relative rates. It is important to the shipper of freight that a carrier shall be responsible and shall give regular service. In its best days the river steamboat could not compete with rail service in these particulars. The water transportation line is subject to interruption by floods and by drought. The ice in winter in northern latitudes puts it out of business entirely during several months of the year. The risks of loss are many times as great as on goods sent by rail. These and other conditions, which will be more fully discussed later, greatly handicapped the water route in the competition.

The closing decade of the century was a period of great agitation among those who sought to maintain the position of water transportation. The idea of water-route competition benefiting the public had become firmly fixed. Congress undertook appropriations for waterway improvements on a larger scale than ever before.

President Roosevelt's Advocacy of Waterways

At the close of the century practically all of the old inland canals had either been abandoned or had lost all commercial importance, except the Erie Canal, owned by the State of New York. This was so dilapidated, and traffic on it was so rapidly declining, that it was clear that this canal also was rapidly becoming obsolete. This was the situation that confronted Theodore Roosevelt when he became Governor of New York after the Spanish War; and he appointed a commission to investigate and report what action the state should take.

The commission recommended the reconstruction of the Erie Canal as a large barge canal, at an estimated cost of $101,000,000. That work was undertaken and is now practically completed.

The interest in waterway development which Colonel Roosevelt acquired at that time was doubtless one factor which led him to devote such energy to the Panama Canal enterprise when he became President. He also became strongly impressed with the waterway propaganda then current, and lent the influence of his magnetic personality to furthering waterway development. In 1907 he appointed an Inland Waterways Commission "to prepare and report a comprehensive plan for the improvement and control of the river systems of the United States."

The commission was largely made up of men identified with the Roosevelt policies, and committed to a considerable extent to the current agitation in favor of water-transportation development. It was not to be expected that a commission so constituted and appointed with such instructions would bring in a report in any way antagonistic to waterways. The commission, however, in the face of the facts which were revealed by the investigations of its experts, could not lay out and recommend for adoption any such great system of inland waterways as was doubtless expected at its creation. Instead, it recommended the establishment of a permanent Government body to plan systematically for waterway development. The report also contained intimations that a considerable part of the waterways system existing and planned was of doubtful value—to put it mildly. One notable clause in the report read:

"We recommend that any plans for improving the inland waterways shall take account of the present and prospective relation of rail lines to such waterways and shall ascertain, so far as may be, whether such waterways when improved will be effectively used in the face of railway competition."[2]

At the time when this report was rendered Congress and the President were at loggerheads. The report of the commission, which was appointed by the President without authority from Congress and which had no appropriation to pay for its work, had little influence with the legislators at the capital, and no action was taken on the Inland Waterway Commission's recommendations.

The only attempt which the Government has ever made, therefore, to investigate the water transportation situation (and even this was not a broad, unprejudiced investigation) has had little or no influence on its action. The Government has since pursued its work of waterway development as it always has done, without any systematic plan or policy. A waterway commission provided in the rivers and harbors bill of 1917 was never appointed by President Wilson.

The Organized Promotion of Waterway Projects

The chief influence which has controlled the Federal appropriations for waterways is the organized propaganda in favor of such appropriations which has been carried on in wholesale fashion for many years. This propaganda has been successful in creating a widespread public opinion in favor of waterways. The public, and especially the commercial interests, implicitly believe that the waterway is inherently a cheaper means of transport than the railway, and that the provision of a waterway at Federal expense will therefore benefit the adjacent shippers and communities. Commercial organizations, therefore, can usually be officially enlisted in favor of waterway appropriations. Others active in promoting waterways are those interested in steamboat lines and in contracts for work on waterways. Still more influential are the interests which seek to have the Federal Government improve rivers ostensibly for navigation, but actually for flood protection.

With this pressure behind Congress, it is entirely natural that appropriations for waterways have been liberal. The individual Congressman has no means of sifting the claims made by the waterway promoters, and he has not the technical knowledge needed to uncover fallacies in the arguments presented. Very little attempt has been made to expose these fallacies. Arguments against waterway appropriation have been generally combated by the waterway promoters with the charge that the objector was "working for the railway interests."

There has thus grown up in the public mind the belief that advocacy of waterways and defence of water transportation are closely related to advocacy of public interests instead of private interests; of free competition in transportation rather than monopoly; of conservation and utilization of natural resources for the public benefit.

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[2] A report on transportation by water in the United States was made by the Commissioner of Corporations at about the same time as the Inland Waterways Commission's report. This report was largely inspired by the theory that the cause of the decline of water transportation was the lack of proper terminals for freight handling, and especially the control of water terminals by railways. Neither of these investigations, therefore, was undertaken as a broad, unprejudiced study of the water-transport situation; and it is easy to detect in the reports the personal views of individual members. Nevertheless, these reports and the studies by expert investigators which accompanied them are the most nearly complete and valuable record of water-transport conditions in the United States that has ever been made.

This is so well recognized that a necessary plank in most political platforms for many years has been a declaration in favor of waterways. The candidate for public office feels sure of approval when he throws into his speeches a few ringing sentences urging improvement of the waterways and condemning the railways. It would be useless for him to pursue any other course. Were he to voice a doubt as to the soundness of the lavish expenditure on waterways, he would be assailed on every hand with quotations from many supposed authorities, all proving him in the wrong, and grave doubts of his sincerity and honesty would be at once aroused.

III—Changes During the Past Twelve Years

When the Inland Waterways Commission made its investigation a dozen years ago, it was taken for granted that the inland waterways ought to be improved and put into use. There were at that time enough of the old-time river steamboats still running on Western rivers to encourage the belief that inland water navigation might be revived and again become important. The cry had long been, Let the Government improve the channels, and the commerce will follow. The channel improvements had made great progress, and speedy results were looked for.

These results have not materialized. Instead of a revival of water transportation, there has been a continuous decline. The great expenditure of the Government on channel improvement has had, broadly speaking, no results. On the improvement of the Mississippi River below Rock Island, Ill., the Government has spent about $100,000,000, though, to be sure, a large part of this went into flood protection. The Mississippi is deeper, and better for navigation, than the Rhine, Europe's greatest interior waterway. Yet the Mississippi has been practically deserted by through traffic. On that river and most of its tributaries, on many of which the Government is still building and maintaining costly works for channel improvement, the few boats which remain are carrying local business only.

The official statistics giving the tonnage of waterborne commerce on inland rivers are misleading, because many inland rivers are still extensively used for floating logs and timber, and also because of the great increase in the use of rivers as a source of sand and gravel. To credit the Government's channel improvement works with the tonnage of logs floated downstream and with the tons of sand and gravel dredged from some nearby bar and towed a mile or two to a convenient site for unloading, is absurd. In most cases the sand and gravel would have been as easily obtained and the logs would be as readily floated with the river in its natural condition.

The various "projects" under which improvements of inland rivers are now being prosecuted were adopted in most cases many years ago. Many projects had their first inception during the '80s or '90s, when the country had just become aroused to the fact that the river steamboat was yielding to railway competition, and when the public demand was urgent that the waterways should be improved to hold their own with the railways. Where projects have been revamped it is generally with the idea of reconstruction on a larger scale. Very seldom has the question been squarely faced whether the time had not passed when the channel could be profitably used for navigation.

Probably the most powerful influence back of the campaign for Federal expenditure on waterways has been that of the property owners in the Mississippi valley. One of the most valuable public improvements of the last half century is the reclamation of the fertile lands along the Lower Mississippi River by the construction of levees and bank revetments, to protect the land from floods and make permanent the channel of the river. A large part of the money for this work has been supplied by the Federal Government; but its expenditure has been made ostensibly for the improvement of navigation. Three years ago a new precedent was established, and Congress made a direct appropriation for flood prevention on the lower Mississippi River. Thus one of the chief sources from which the propaganda in support of river appropriations has been financed has now been removed, and there is that much better chance of having the case of the waterways considered fairly on its merits.

No change during the past dozen years has been of greater importance in its bearing on the waterway question than the altered situation of the railways.

From the time when competition of the railway with the steamboat first became evident, the argument has been potent that waterways were a public necessity to keep down railway rates. That argument had its birth in the days when belief in railway competition as a necessary protection to the public was still almost universal. Better even than railway competition, it was held, was water competition, because steamboat lines could not be combined and controlled like competing railway lines.

Good Results From Government Railway Control

Of course, this argument for waterways became invalid when the Government established its direct control over railway rates. There still remained, however, a widespread belief in the value of water competition. Not until the recent transfer of the railways to Government control and operation has the public been able to view this matter in its true light.

It is now clear to everyone that the railways must have rates high enough to live on and continue operation; and not only that, but enable them to expand and develop to meet the country's necessities. If rates are insufficient for this, the deficit will have to be made up from the public treasury with money raised by taxation, as is actually being done today. If the dream of some of the waterway promoters were realized and "a comprehensive system of waterways" were constructed, and if that system operated to reduce railway rates, the deficit to be made up by the taxpayers would be that much larger.

One finds repeatedly in waterway literature the argument that waterways would be justified even if they were wholly unused, merely because of their influence in reducing railway rates. The present situation of the railways shows the absurdity of this reasoning. If the waterways were able to divert from the railways a large amount of business which the railways could handle at a profit, the deficit for the taxpayer to shoulder would be even greater.

Thus the great experiment of Government railway control, undertaken for the war emergency, has been a most valuable demonstration that the railway, as an

absolute public necessity, must have rates high enough to enable it to live, and that any water transport line must be justified by what it can accomplish as an economic carrier. As a mere competitor of the railway it will be an injury and not a benefit to the public.

Government operation of the railways has also made it far easier to demonstrate to the public that unnecessary duplication of transportation lines is a waste and not a benefit. To build two railways where only one is needed, or both a railway and a waterway where the railway alone is sufficient, is a waste of capital and labor which results in a perpetual burden on the public. The waterway, to be economically justified, must be shown to be needed by the public in addition to the railway facilities, and must be needed to an extent that will bring traffic to it sufficient to yield a fair return on the cost.

Waterways To Relieve Railway Congestion

One of the arguments for water transportation which has been oftenest repeated is that waterways are needed to supplement railway facilities at times of railway congestion, so that the public need not lack for transportation at such times.

It is doubtful whether the many eminent men who have put forward this argument ever gave it enough serious study to find out what it would involve in its practical application. Since the argument has been put forward by various high authorities, it may be appropriate in this place to inquire what would be involved if waterways were built and used merely to carry the railway "peak loads."

Under normal business conditions, the railways of the country are capable of carrying all the business offered. At certain intervals, however, business expands more rapidly than railway facilities, and congestion of traffic and car shortage prevail. In 1906 and 1907 the greatest car shortage ever known in the United States occurred. In February, 1907, the demand for cars by shippers was 125,000 in excess of the supply. It was at exactly this time that the agitation for Government expenditure on waterways was most aggressive. Doubtless, many thousands of business men considered it fully demonstrated then that "a comprehensive system of waterways" was urgently needed to carry the traffic which the railways were unable to handle.

Near the close of 1907 came a business panic. The car shortage promptly disappeared, and a huge car surplus took its place. In 1908 and 1909 the railways of the United States had an average of over 100,000 idle cars. Companies which were hard pressed financially had to build many miles of new track on which to store their idle cars. Not for eight years—until 1916, when the war business came on—did the country again experience congestion of railway traffic and car shortage.

After the armistice was signed, railway traffic fell off materially, so that whereas in 1918 various railway companies were struggling to get each its share of the new cars which the Federal Railroad Administration was building, by the spring of 1919 the different companies were politely waiving their claims, and each was urging that some other road certainly ought to have its need for cars supplied first!

Suppose now it were seriously proposed to provide waterways, boats and terminals to carry traffic at such times only as the railways were unable to handle it. Merely to state such a proposition is to demonstrate its absurdity. Who would pay for boats to be used only a few months at a time, once in half a dozen years or so? No business concern would do it—and if it did its losses would soon put it out of business. The Government treasury might be called on to stand such a loss; but a transportation business which operated only in a rare emergency would certainly prove inadequate and inefficient when the emergency came. This is not a mere theory; it has just been proved by actual experience. During the memorable railway blockade of 1917-'18 the inland waterways were available, and a considerable number of old boats were obtainable for use on them, but the organization to use the waterways effectively was lacking, and consequently the waterways remained unused when transportation was in more urgent demand than ever before.

The absolute impotence of the waterways to supplement the railways at that crucial time is best shown by figures: The total river traffic of St. Louis was 151,590 tons in 1916; it was 150,380 tons in 1917, and in 1918, when railway congestion was most acute, it was 129,495 tons. In contrast with this, the railway traffic of St. Louis was 76,126,000 tons in 1917, and 72,354,000 tons in 1918. These figures show not only that river traffic actually declined during the year of greatest railway congestion ever known, but that the volume of railway business is so enormous that if the waterway were to be a really valuable supplement to the railway in times of traffic congestion it would have to be equipped with boats and terminals on a huge scale.

It will not escape notice, too, that only in a very few locations are waterways available to supplement railways, and that the worst railway congestion ever known in 1917-18 was during the winter months when the waterways were closed by ice anyway. Sufficient has been said, however, to show how chimerical is the proposition to use the waterways to relieve railway congestion.

Relative Capacity of Railways and Waterways

An argument closely akin to the one just dissected is the argument that waterways are needed to supplement the railways because of the great capacity of the waterways. It is known that a large amount of new capital must be invested in the country's railway system to enable it to expand to meet the growth of traffic, and it is urged that this increase in the country's transportation facilities should be made in the water transport lines rather than in the railways, on the ground that a given expenditure of capital in waterways would produce a greater additional capacity.

The facts and figures to substantiate such a claim, however, are lacking. The common idea that a waterway on a natural river costs substantially nothing to make and to maintain is fallacious. On the contrary, the few inland waterways of the United States, where there is any chance for a revival of traffic have cost as much per mile to improve as the cost of building a first-class railway.

Besides this, the traffic capacity of a railway is almost without exception fixed by the capacity of its terminals. The work on expansion of the railway system during the past decade has been almost all

devoted to terminal enlargement and improvement, or else to extensions and branch lines in districts far inland, removed from navigable waterways. One can hardly identify a single piece of railway construction carried out during the past decade which would have been less necessary by reason of any practicable expansion of waterways.

The capacity of the waterway, like that of the railway, is fixed by the capacity of its terminals. In all the estimates of the capacity of water routes which have been made, one will look in vain for estimates of the cost of terminals commodious enough to care for a volume of traffic equal to the estimated capacity of the waterway.

Building Boats for Inland Waterways

Nothing is more illuminating as to the present condition and future prospects of inland water transportation than the condition of the boat building industry. If there are conditions which make probable an early revival of transportation on inland waters, those engaged in building craft for use there should be the first to foresee and prepare for such a revival.

The United States Census Bureau has just issued a bulletin giving statistics of shipbuilding for the entire United States, and containing figures for the industry for the years 1916 and 1914. The accompanying table gives the figures of most interest for the year 1916:

SHIPBUILDING IN 1916 ON INLAND WATERS

	Great Lakes	Mississippi River and tributaries	All Other Inland Waters
Number of concerns	131	101	97
Persons engaged	9,567	2,419	679
Capital employed	$36,024,371	$4,570,879	$1,368,762
Value of products	22,094,456	5,034,674	1,361,470
Value of work on new vessels	13,101,506	1,560,037	66,184
Value of repairs on vessels	6,465,800	1,063,853	256,549
Value of all other products	2,051,126	2,082,829	194,326

VESSELS LAUNCHED DURING 1916

Number	89	234	9
Gross tonnage	121,234	50,593	925
Steam Vessels:			
Number	46	20	.....
Gross tonnage	102,464	3,618	.....
Barges:			
Number	13	190	5
Gross tonnage	4,100	46,426	880

It will be seen from this table that the building of boats for use on the Mississippi and all its tributaries is a business only one-ninth as large as shipbuilding on the Great Lakes. It employs about $4,500,000 capital and fewer than 2500 workmen. It is carried on by small concerns with an average capital less than $50,000 and employing fewer than 25 men. These concerns built in 1916 only 20 steamboats averaging 180 tons in size. They were occupied chiefly with repair work and the building of barges. The average size of the barges built was only about 250 tons.

It may be thought that the showing for 1916 represents a paralysis of business due to the war. Comparison with the figures for 1914 shows that, on the contrary, the war conditions stimulated the business considerably. The business of 1916 was more than double that of 1914.

In studying these figures, it must be remembered that the Mississippi and its navigable tributaries have an extent of several thousand miles, and there is in the aggregate a considerable amount of local business on these rivers, where small craft serve river communities which may not be reached by a railway. The building of boats for this purpose, and the building of boats to maintain the great fleet of vessels which the Government keeps busy on channel improvement works, are sufficient to account for the amount of boat building which is shown in these census statistics.

The Effect of Changes in Labor Costs

Few are aware of the revolutionary change in the conditions of water transportation which has been brought about by the enormous increase in the cost of labor. The increase has, of course, had serious effect on the railways and is, indeed, chiefly responsible for the present great deficit in railway net earnings. The water transport lines have been hit still harder; for the steamboat on inland waterways, being of relatively small tonnage, requires a much larger labor force to produce a thousand ton-miles of transportation than does the railway.

Those who hope to see the old-time steamboats come back to the Mississippi and other Western rivers have only to consider the cost of operating those boats at the present wage scale to see how baseless is such a hope. It was necessary for the steamboat which plied up and down the river, making frequent stops, to carry besides her regular crew of engineers and stokers a swarm of deck-hands to hustle freight on and off the boat at the landings, and bring cordwood on board for use under the boilers.

Today the wages of a deck-hand are at least four or five times what they were forty years ago, and the crew's wages are proportionately raised. No boat can afford to carry a crew large enough to handle freight on and off at landings in the old way; especially is this the case if boats are to be used for other than local traffic and to make long runs, as from New Orleans to Memphis or St. Louis.

It is only on these long runs, however, that the boat can have any chance of competing with the railway. On short hauls the difference in cost by rail and by boat will be too small to be controlling, and the shipper will send by whichever route offers best service in other respects.

Lack of Stevedores at River Ports

But on the long-distance voyage, what will the steamboat operator do about handling cargo? It takes ten days to a month for the voyage between New Orleans and St. Louis. It would be absurd to pay the wages and board during the voyage of sufficient deck-hands to handle the cargo at the terminals. The river boat, therefore, must now, like the ocean vessel, rely on local stevedore labor to load and unload her freight.

At New Orleans, as at any other great seaport, stevedoring is an organized business, and there is comparatively little difficulty in getting the cargo handled with reasonable promptness and moderate expense; but this is not the case at St. Louis or at any other city on an inland river. The volume of river steamboat business has for years been too small and too irregular to support any reliable stevedoring concerns. The river steamboat operator, therefore, must use such floating labor as he may be able to pick up to do the work of taking on and discharging cargo at a river port. Such labor is very inefficient and

expensive. This condition is bound to continue, no matter how much money or how intelligent design may be expended on terminal facilities on inland rivers, until river transportation becomes a large business.

Again, the movement of vessels in river traffic is subject inevitably to great variation, so that the time of arrival of a boat at a port is uncertain. In order to keep stevedores on hand to be available when wanted, a great deal of idle time must be paid for. Even then, a boat will be subject to considerable delays in port waiting for a gang to handle her goods. This is true even of ocean transportation. In times when business is active and labor scarce, as was the case during the war, it is not uncommon for ocean vessels to be detained for days awaiting stevedores to handle the cargo.

High Labor Costs Hurt Coast Steamer Lines

Probably few are aware how severely the great advance in wages has hit the coastwise steamer lines. The ocean vessels were able to meet the wage increase by an even greater proportional increase in their cargo rates; but the coastwise vessels can obtain business only by maintaining rates below those of the railways, and the railway freight rates were raised only 25 per cent. The result has been to lower earnings in many cases below operating expenses. The Clyde Steamship Line in February, 1919, abandoned operation of its line from New York to Mobile and Tampa, which it had operated for 16 years, its line to Wilmington and Georgetown, in operation for 30 years, and its Philadelphia and Norfolk line, with a record of 50 years. On June 7 its line between New York and Philadelphia was also discontinued.

The longshoremen's strike, which tied up the port of New York for more than a month in October and November, 1919, was precipitated in part by the attempt of the Federal Wage Adjustment Board to fix a lower rate for handling cargo for coast vessels than for ocean vessels. The board publicly announced as its reason that the coast lines were operating on so narrow a margin that to grant the increase the longshoremen asked for, and which the board held was justified by the increased cost of living, would put some of the coast lines out of business.

Here are water routes with all the advantages of the deep water of the ocean and with long-established terminals for the economical handling of traffic, abandoned or on the point of abandonment because of inability to pay expenses in competition with the railway lines. If such water routes are unprofitable, it is surely worth inquiry whether the long-accepted idea that inland water transport in artificial channels is cheaper than rail transport holds good under present-day conditions.

IV—Transportation on the Great Lakes

There is one inland waterway in the United States on which traffic has increased at an enormous rate; and which has fully justified all the expenditure which the Federal Government has made on its improvement. This is the waterway through the Great Lakes.

Before the railway or the steamboat came, these great inland seas were the chief means of reaching the interior of the continent. Most of the early settlers of the region bordering the lakes emigrated by this route. The application of steam to navigation and the opening of the Erie Canal greatly stimulated the flow of population to this region, and the current of east and west traffic on the lakes assumed large proportion.

It was not till after the middle of the century that the railways between the Eastern seaboard and the Central West were developed to a point where they could compete at all efficiently with the lake vessels, and then their competition was only for merchandise freight. The bulk freight which forms the largest item in tonnage statistics could be carried so much more cheaply by the lake vessels that the combined lake and rail route was still the cheaper for through traffic, notwithstanding the cost of transferring freight from the cars to the boats at Chicago and back to the cars again at Buffalo.

Freight-Transferring Machinery

As the cost of rail transport was steadily reduced, lake transportation would have fallen off as river transport did, except that the cost of transferring bulk freights on the lakes was also reduced. Nowhere else in the world has machinery effected such marvelous reductions in the cost of transferring bulk freights between the railway car and the ship as on the Great Lakes. Nowhere else in the world does there exist so huge a volume of traffic in bulk freights as flows between the ports at the head of Lake Superior and those on the lower lakes. It is this huge volume of business, indeed, which has made possible the great investment in labor-saving machinery at the terminals.

About three-fourths of the traffic on the lakes is in iron ore and coal, transported in vessels of much larger capacity than the average ocean freight steamer. These vessels take on their load of ore at the head of the lakes from huge bins which discharge their contents into the hold by gravity. Only a few hours' stay in port are necessary before the vessel is ready to start on her return voyage. At the lower lake port the ore is removed from the hold by enormous automatic grab-buckets. Coal for the return trip is loaded on the boats by machines which pick up a full-size railway car, invert it and pour its burden of 50 to 70 tons of coal into a chute that discharges into the vessel's hold.

This machinery so greatly reduces the cost and the time necessary for the transfer between the railway car and the vessel that such a double transfer becomes possible without absorbing the saving made by the lower cost of the movement by vessel compared with the movement by rail.

To a considerably less extent, the same thing is true of the handling of wheat and other grains. The cost of transfer here, however, is much greater, and the net saving by the water route plus the transfer cost is not enough to prevent a large movement of grain to the seaboard by all-rail routes.

Lake Navigation Is Unique

The lake traffic is unlike any other inland water transportation. The vessels which carry it must be able to stand waves and storms only less severe than those of the ocean. They are deep draft vessels; not as deep, indeed, as the large ocean freighters, because the principal lake harbors permit a draft of only 21 ft., but substantially like ocean steamers and entirely

unlike the broad, shallow-draft vessels used on other inland waterways.

The lake ore and coal freighters carry traffic at a ton-mile cost as low as that of ocean steamers, notwithstanding the handicap they are under of a comparatively short voyage and of idleness during five months of the year when ice blocks navigation. They are able to do this because of the machinery for rapidly loading and discharging the vessels which reduces the necessary time in port to a few hours and reduces to a very low figure the terminal expenses per ton carried.

It is important to understand clearly the lake traffic conditions, because one of the stock arguments of waterway advocates has long been the great volume of traffic and low rates on the Great Lakes. It seems almost needless to say that the conditions on the lakes cannot be duplicated on any inland river. Not the depth, the volume of possible traffic, or the huge expenditures on terminal machinery exist on any other inland water route; yet time and again the Great Lakes conditions are cited by waterway enthusiasts as illustrations of what might be done were "a comprehensive system of waterways" available.

A great amount of time and money has been expended in promoting various schemes for "deep waterways," on the assumption that because water transport is cheap on the deep water of the ocean and the lakes, goods could be carried at similar low cost on artificial deep-water channels.

The fallacy of this idea is made plain by the following quotation from the report of the Commissioner of Corporations on transportation by water, issued in 1909:

> The expense of securing channels of sufficient depth in rivers and canals for ocean or the larger Great Lakes steamers would, except in a few cases, be prohibitive if at all possible. If a sufficient depth were secured, other conditions would prevent their use by oceangoing vessels to any appreciable extent. . . . The important question to be determined is the relation between the cost of improving waterways and terminals and the reduction in transportation charges made possible by such improvements. This involves careful engineering study of the cost of improvements and the cost of transportation on waterways of different kinds.

Again, the great reduction in the cost of handling freight at the lake ports is made an argument for similar facilities elsewhere. But the great investment in ore bins and automatic shovels and car dumps at the lake ports is only warranted because of the volume of bulk freight traffic handled. Such low cost of handling has never been approached in the handling of merchandise freight at terminals. At these very lake ports there are few facilities for the economical handling of merchandise freight.

These are some of the reasons why the experience on the Great Lakes is not a safe guide for dealing with other inland water routes.

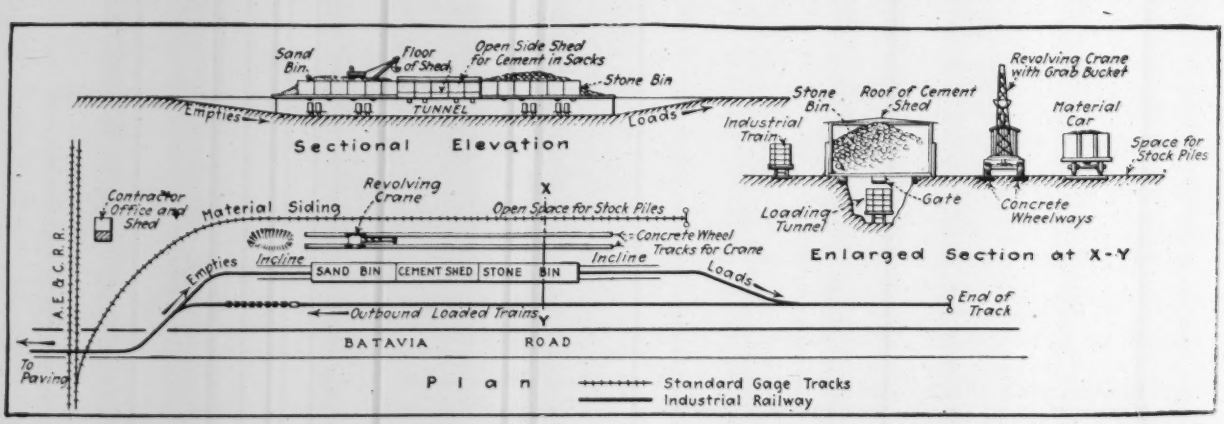
(To be continued)

Concrete Road Contract Has Plant for Rapid Progress

Batch Boxes Loaded in Tunnel Hauled on Industrial Railway With 5 Per Cent Grade to Large Mixer—Material Yard at Railway Crossing—Nine-Mile Contract

A TUNNEL system for loading batch boxes, a revolving crane traveling on concrete wheelways, a concrete mixer of high capacity, and large machinery equipment, are features of a construction outfit that has made a concreting record of a foot a minute on a nine-mile stretch of the Lincoln Highway near Wheaton, Ill. This record has been made only intermittently, owing to conditions of the material market and of transportation which make it impossible to maintain a full supply, while a 5% grade between the material yard and the mixer also causes some interruption of supply to the mixer.

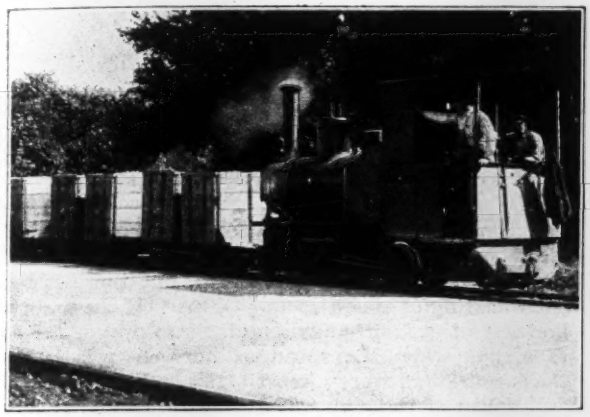
The layout of the material yard is shown in the accompanying drawing. This yard is located about midway on the stretch of road, at the intersection of the Aurora, Elgin & Chicago Electric Ry., a spur from which is laid into the yard. Most of the cars are delivered in this way, and a recent railway strike lasting some weeks caused serious delay to the work. Some cars were shipped over the Chicago & Northwestern Ry. to Wheaton, the materials being then hauled to the yard in wagons, but this supply could not meet the requirements of continuous, rapid work. Slow and irregular deliveries have been a constant



LAYOUT OF MATERIAL YARD FOR NINE-MILE CONCRETE ROAD—BATCH BOXES ARE CHARGED IN TUNNEL FROM BINS LOADED BY ROAD CRANE

trouble, so that progress is governed largely by conditions beyond the control of the contractor or his superintendent.

Batch boxes carried on the flat-cars of an industrial railway are employed for hauling material to the mixer. These are run under bins in the usual way, but instead of elevating the bins they are placed upon the ground over a tunnel or subway in which the track is laid. The sand and stone bins have the bottoms formed of transverse timbers (old car sills) laid close together, each bin having four loading gates. Between the two bins is a covered platform for the cement, having canvas side curtains for use when the

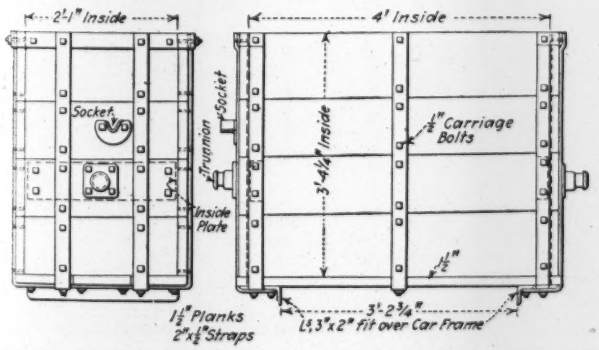


TRAINS OF CARS CARRYING BATCH BOXES SERVE CONCRETE MIXER ON ROAD WORK

plant is not working. In the floor of this platform are four wooden chutes, through which the cement is poured from the sacks by hand.

Bulk cement was tried at first, being stored in a bin with bottom gates. No measuring hopper was used and it was found impracticable to handle the direct flow. At times the cement would flow steadily like sand, but at other times it would come down like water, overloading the box and spilling out into the tunnel before it could be stopped. To install measuring hoppers, the bin must have been raised or the tunnel track lowered, but after some changes and experiments this plan was abandoned in favor of the method adopted.

The batch boxes are of the tilting type, as shown in one of the drawings, the contractor preferring these to drop-bottom boxes. They are built of 1½-in. plank and iron straps put together with ½-in. carriage bolts. The inside dimensions are 48 x 25 in., and the boxes are 40¼ in. deep; the capacity is about 28 cu.ft. This was the first job on which these knockdown batch boxes were used. The iron parts were furnished by the Koppel Industrial Car & Equipment Co., being shipped in bundles to the job, where the contractor supplied the wood and did the assembling. There are trunnions on the ends, placed below the center of gravity so that the box will tilt readily. One end also has a catch or socket for a pin in the handling bail used at the mixer, this pin preventing the box from tilting prematurely.



BATCH BOXES TILT BY GRAVITY ON TRUNNION SUPPORTS

Two boxes are placed on each car. The empties are fed into the tunnel by gravity under control of brakes, a number of the cars having hand brakes. Two men in the tunnel place the cars under the gates of the sand bin and fill the boxes to a gage mark. They then shift the cars to the cement chutes for a four-sack charge, then on to the stone or gravel bin, and finally to the mouth of the tunnel.

A revolving crane on wide-tired road wheels and carrying a ¾-yd. grab bucket travels on a roadway between the bins and the railway siding, this roadway having concrete wheelways to give a good track for the crane in all weather. These wheelways are 6 in. thick and 24 in. wide and are 4 ft. apart, but as they were put in service too soon the concrete cracked badly and timber sills have been laid upon them. This crane unloads the cars and places the materials either in the bins or in stock piles from which they are rehandled as required. It is found that the crane can unload cement in sacks more rapidly than in bulk. A sack carload equivalent to 250 bbl. can be unloaded by two men in about four hours, as against five to six tons for an equal quantity of cement in bulk. As many as 18 sacks are handled by the bucket at one load. A slight grade on the siding enables the material cars to be moved along by means of pinch bars.

Portable track sections are used for the 24-in. industrial railway, these sections being 15 ft. long, with 20-lb. rails bolted to steel ties and having fishplate joints with four bolts. The track is laid along the side of the roadbed, outside the line of the forms, except that where the concrete road has been completed for some time the track is shifted upon it, being ballasted lightly with earth. Elsewhere the ballast is mainly stone obtained in dressing the old macadam surface.

Two grade crossings occur on this industrial railway, as shown by the plan. At the spur into the material yard the industrial line is at such a level that a 15-ft. section of track can be laid across the rails of the spur, being removed when this line is not in service or when cars are to be moved on the spur. At the crossing of the double-track main line, the industrial track is embedded in concrete, flush with the tops of the rails. This concrete is laid close against the outer side of the 20-lb. rails, while on the inside it is laid between angle guard rails which form the flangeway for the narrow-gage equipment.

Two 7-ton locomotives and a number of cars and batch boxes constitute the transportation equipment serving the mixer. Practically all trains are pushed by the engines. The schedule provides for the leaving of trains from the material yard at 30-min. intervals. Each engine can take 12 cars (with 24 batches) on

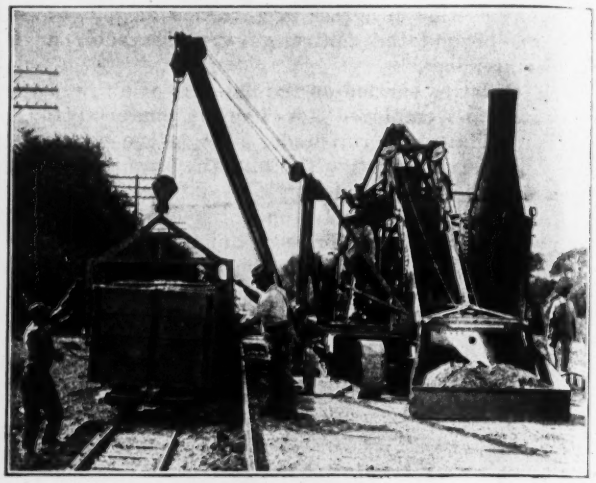
fairly level ground, but the heavy grades in this case limit the trains to eight cars, as a rule. In regular working, the first engine pulls a train from the tunnel and then pushes it over the running track as far as the foot of the 5% grade, where it puts four cars on a stub siding and so doubles the train over the grade to a turnout on the level. This is about a mile from the yard. The second engine, which has placed a train of empties on the turnout, pushes the loaded train on to the mixer, while the first engine goes into the turnout and pushes the empty train back to the yard.

At the mixer the cars are handled by three men, who place them in position for the derrick and then run them into a siding. Two of these men attach the boxes to the hoisting cable, swing them over to the charging skip, dump them and return them to the cars.

A mixer of 21-ft. capacity is used, and can deliver concrete sufficient for an advance of 1 ft. per minute for an 18-ft. slab of 8-in. concrete. It is estimated that the mixer is capable of making an advance of 500 ft. per day, but under the conditions noted the maximum so far has been about 300 ft. In two consecutive runs the 16 batches of each train were handled in 26 min. and 31 min. from the time the first batch box was lifted off the car until the last batch was dumped on the roadbed. A 1: 2: 3½ dry mixer of jelly-like consistency is produced which meets the slump test, using ordinarily 15 gal. of water per batch, but at times the concrete is fairly wet. Water is supplied by a pipe line laid along the road and connected to a city hydrant.

Attached to one forward corner of the mixer frame is a derrick mounted on a two-wheeled truck and with the hoisting line led to a drum on the mixer. This line carries an iron bail, the vertical sides of which end in loops to engage the trunnions of the batch boxes, while a pin thrust through a hole in one side of the bail engages the socket on the box, so that it cannot overturn while being swung. A bottom-discharge bucket places the concrete, this bucket traveling on a horizontal boom.

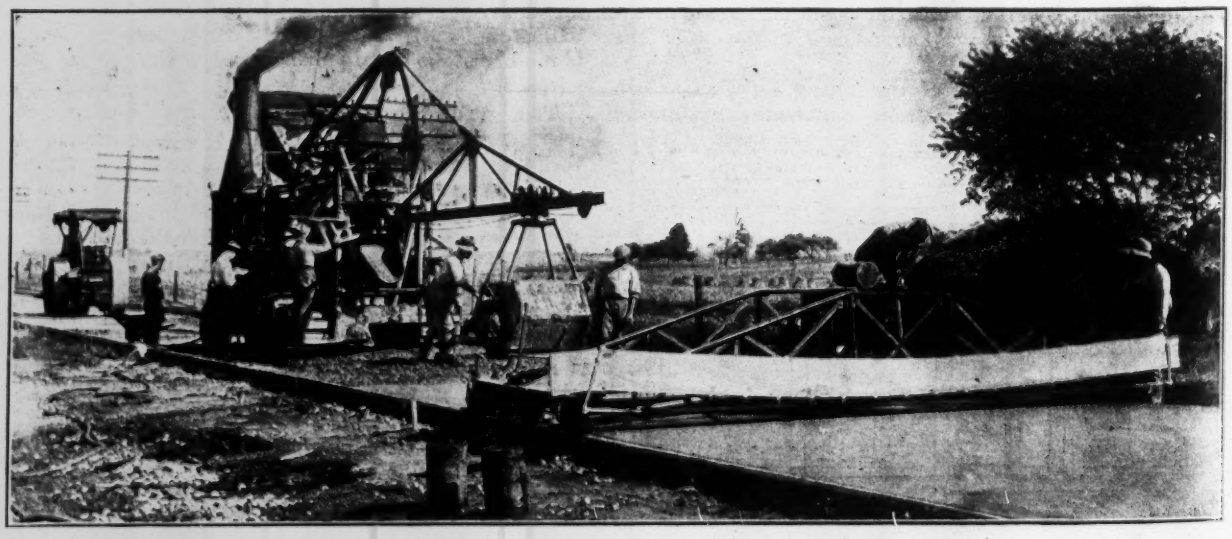
As soon as the concrete is spaded between the steel forms, a mechanical tamper is run over it, but usually



CONCRETE ROAD WORK WITH TILTING BATCH BOXES SWUNG FROM CAR TO CHARGING SKIP BY A PONY DERRICK

the concrete is so deep that it piles up against the strikeboard and the men have to spade it away. The same machine gives a belt finish, but there is some hand floating of rough spots. On part of the work, the belt gave the familiar triangular marking of the surface, but when the speed of advance was reduced these markings were almost straight lines across the full width of the slab. The edges are finished in the usual way.

Canvas covers are laid directly upon the concrete when it has set, to protect it from the drying action of sun and wind, these covers being kept wet. Both earth cover and ponding are being used for curing, but here another trouble has been experienced in occasional interruption of the water supply, which is piped from city hydrants through metered connections. No expansion joints are used, the only joints being those at the ends of each day's work. Transverse cracks have already appeared, and will be filled with tar, this filling being a final treatment of the road. Graders will be used to remove the earth cover.



TAMPING MACHINE WITH FINISHING BELT FOLLOWS MIXER CLOSELY

and graders or scrapers will build up the shoulders after the concreting has been completed.

Some heavy grading is required to lower old summits, but in the main the surface is a road of water-bound macadam laid only a few years ago. Large graders and scarifiers are used to level the surface to grade, the machines being hauled by powerful gasoline tractors. After the forms are placed the roadbed surface between them is dressed to a templet by hand and is then finished with a heavy steam roller.

The concreting gang consists of ten men with a timekeeper, distributed as follows: Three men handling batch boxes and cars; one operating hoists of derrick and charging skip; one firemen; one mixer operator; two spreading concrete; one operating tamping and belting machine; one floating rough spots and dressing the edges.

This work is being done on a joint contract by J. A. Ross and the Calumet Concrete Construction Co., Chicago, with Eben C. Chase as superintendent. It is under the direction of George N. Lamb, district engineer of the State Highway Department, Illinois Department of Public Works, with M. W. Embody as resident engineer.

Engineering Education and Life

Technical Training, if Broadened, Should Fit Men for Thousands of Executive Positions Outside of Engineering Field

By Cyrus Townsend Brady, Jr.
Resident Engineer, United States Steel Products Company, Buenos Aires, Argentina

FROM time immemorial man has built, with such degree of elaboration as he was able, objects to be used for his own comfort and convenience. At a certain stage of magnitude and complexity these objects or structures are called "engineering works," and a high degree of coördination of the various forms of man's mental and spiritual faculties then becomes necessary to insure that they may successfully fulfill the sole purpose for which they are conceived—the welfare of men.

Before that purpose is accomplished, these steps have usually to be mounted: (1) Exercises of the imagination—the mind must conceive existence of the project; (2) other minds must be interested in it—promotion; (3) a preliminary study of feasibility, cost and commensurate return, commercial or moral; (4) legal difficulties must be overcome; (5) finance; (6) final investigation, surveys, etc.; (7) the general design as influenced by degree of permanency desirable, future operation and maintenance, transportation, materials, labor, workmanship, etc.; (8) the detailed design; (9) preparation of specifications, letting of contracts, etc.; (10) construction; (11) operation; (12) management and marketing of product; (13) maintenance.

All these steps are of nearly equal importance and no one of them is of the slightest value to the world. Engineering projects are carried out for one reason and one only—that men may use them, and until they are put into successful use they are truly "useless." It is ignorance of this principle which causes woeful misconception in the minds of engineering students, to whom the whole of engineering seems comprised in step 8, although there is a vague recognition of an ancillary importance in steps 6, 7 and 10.

The schools are not entirely to be blamed for such misconception, as it is impossible to instill the absolutely essential habit of accuracy without insistence on the minutiæ of calculations. Yet the standard engineering course does tend to imbue the student with a concept of the engineer as a walking calculating machine who knows how to run surveying instruments. The real engineer is, or ought to be, much more than that. While it cannot be presumed that any one man will possess a mastery of all the steps previously mentioned he certainly must grasp the basic principles of them all. He should appreciate their relative value and recognize that his own activities are merely some of the various subordidnate functions in the one combined operation.

I believe good would come of abolishing half of the elaborate design courses given in the senior year of the ordinary engineering curriculum and substituting work in the lines of finance, promotion, law, accounting, etc. From matriculation to graduation an increasing share of the students' attention should be directed toward the use and the users of "engineering works," instead of entirely to the works themselves. Is there not a larger field for descriptive courses than is usually conceded? I remember studying in preparatory school the old-fashioned course in ancient history, chiefly concerned with names and dates of kings and battles, and the general view gained of the history of, say Greece, was a dreary confusion of the Delphic amphictyony and the hegemony of Athens. Recently I came across Breasted's "Ancient Times" and found it a splendid example of the new method of treatment in textbooks. The people of the early world are presented with their businesses, their ideas, their arts and sciences, their loves and hates, their everyday lives—in fine, as rational human beings. The history seems to live of itself, to move in one great wave of advancing and receding civilization, to compel the reader to recognize his kinship with them of old time—and it never once mentions the Delphic amphictyony. Why cannot engineering subjects be so taught as to kindle the imagination and fire the enthusiasm, not solely as elegant mathematical propositions, like the theorem of the three moments, but more as the very surest indices of our civilization?

Trained in Science, but not "Cultured"

Much has been written for the technical press concerning the "cultural value of the exact sciences" and Herbert Spencer's "unanswerable arguments" for them. Doubtless his arguments are unanswerable. I have not read them. Of course, any argument by so consummate a master of logic would be difficult of answer by us of less powerful mind—and yet the unanswerable arguments do not obviate the fact that many men trained in science are not what we call, for lack of a better word, "cultured." And especially is this true of engineering graduates. However, as engineering is not an exact, but an essentially empiric science, Mr. Spencer's cultural value may not apply to it. Young engineers are only too often afflicted—I know I was—with a half-hidden scorn of nontechnical, nonscientific ideas, occupations and persons, and with an unpleasant cocksureness as to the competency of their own unaided reason to solve correctly every problem presented to it. It is quite typical of the past century's "I am the master of my fate, the captain of my soul" philosophy.

We may grant that the scientific education need not necessarily deaden the poetic and imaginative faculties, and may lay the blame, in the majority of the cases of this common result, directly on the students themselves. It is they who demand more and more of intensive technical teaching and who are intolerant of anything else. Frequently it is only by severe pecuniary sacrifices that they are able to take their course at all, and the feeling that they cannot afford to devote any time to other topics is but natural. Nevertheless, we must deplore the fact that this attitude leads to an unfortunate repression of some of those higher emotions which are inherent in us all.

True Education Needed by the Engineer

It is a sad commentary on our profession that it is necessary to expend so much energy in urging the "benefits of the study of English for engineers" and similar matters. It goes without saying that every educated man ought to pride himself on speaking his mother-tongue correctly, that he should enjoy the amazing wealth of the world's literature, and that he should appreciate it along with all the other arts which crown civilization; nor can anyone be considered a truly "educated" man who lacks discrimination in these things.

Good taste is largely a matter of education, and requires for its full development and expression a certain amount of leisure and especially the atmosphere of refined surroundings. The low wages of the engineer continually react to prevent his acquisition of the means for the satisfaction of those spiritual necessities, and their lack in turn prevents the full development of his character which would enable him to associate with men of affairs, and to overcome that excessive modesty which is the besetting sin of the middle-aged engineer. Finally the engineer's diffidence is a powerful factor in preventing his better compensation. Painful as it may be to admit this "vicious circle" of reasoning, reflection will suggest many examples of its continual effectiveness. It requires a true act of Christian resignation for many an engineer to continue in his profession; but who outside of it ever awards him even a meed of "psychological compensation" in honor and esteem? What engineering school ever brought this to the attention of its freshman class?

The belief that our engineering training fits us only for technical engineering work is the fundamental cause of our, too often melancholy, lot. In hard times the bachelor of arts who took a college course, or two, in music does not feel that he is thereby bound to hunt only for a job as bass-drummer—he takes the first thing that comes to his hand. Yet it seems that our only recourse is to look for vacancies for draftsmen or surveyors. Our training, provided it were only slightly broadened, should fit us for the thousands of executive positions in which a knowledge of engineering principles is of the utmost value. It should make us useful adjuncts to any kind of manufacturing; to the great field of scientific accounting; to banking institutions; to commercial business, not merely as salesmen of construction materials, but also in general office work. The young graduate must get rid of the feeling that his education has been wasted unless he commences work as drafsman, surveyor or inspector. It will astonish him to know that his ability to figure easily and accurately so simple a problem as the net cost in pesos per metric ton from a quotation in dollars per 100 lb. "less 25, 10, 5 and 5" usually impresses the American executive far more effectively than the display of the most profound knowledge of the theory of the elastic arch. The bachelor of science should feel as free as the bachelor of arts to accept any kind of job he can find. Cleaning ink wells, if necessary as a start, will not hurt him, and soon enough he will find that, beginning with his facility in arithmetic, he will be called upon for greater and broader applications of his scientific equipment and powers of thought. Adequate compensation, continuity of employment and the privilege of associating with broadminded men are not difficult of attainment in the commercial world.

In the great increase of American foreign commerce, due to the war, there have been and are now available many openings for engineers and for men of all business classes who are willing to live abroad. Many inducements have been offered to obtain the right kind of man, and therefore one phase of living abroad is seldom mentioned—that is, that the man's wife practically never shares his enthusiasm for fresh worlds to conquer, and she is almost invariably homesick. I have yet to meet one American girl who really likes living continuously outside the United States. They may be plucky enough not to complain, but the separation from their own people tells heavily on them. Whether the inducements offered ever outbalance the disadvantages is a point of perpetual dispute. Bachelors must take this to heart as well as married men, for after living abroad a short while the loneliness of the life will teach them the truth of Benedick's marvelously logical explanation that when he said he would die a bachelor he did not think he would live till he were married.

Federal Highway Council Urges Removal of Snow From Roads

With the advance of winter, the transportation bureau of the Federal Highway Council is calling the attention of state highway officials to the necessity for the removal of snow from highways as a means of preserving state roads and of maintaining all-year traffic service. Melting snow on roads, it was pointed out by officials of the transportation bureau, tends to soften the subgrade and loosen the base under the wearing surface, and this generally results in ruts which require repairing in the spring. The expense of clearing the snow from the roads, it was said, is less than the cost of repairing the roads after excessive amounts of snow have been allowed to thaw upon them. Traffic in winter over snow-covered roads results in more damage to the roads than more frequent traffic in the spring. Snow removal is also being urged by the transportation bureau as an indispensable part of all-year motor-truck transportation.

In advocating the transfer of short hauls from the railroads to motor-truck routes, the Federal Highway Council emphasizes the imperative need for having motor-truck roads free from snow in winter, pointing out that if motor-truck roads are snowbound in winter the short-haul traffic will necessarily revert to the railroads during that period of the year. State highway organizations are urged to obtain the necessary legislation to enable them to remove snow from the highways so that motor-truck transportation will not be unduly delayed during the winter months.

Mixing Concrete by Surface Areas on Actual Work

How Concrete Proportions Are Controlled and Varied on Construction Work of the Hydro-Electric Power Commission of Ontario—Concrete Specified by Strength

By Roderick B. Young

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During the past year there has been a great deal of discussion as to the proper method of proportioning concrete. The old volumetric system—the 1 : 2 : 4 concrete of the past—has been criticised and new methods advocated which proportion the cement and water according to certain characteristics in the aggregate. So far all the discussion, which was started by Prof. D. A. Abrams of the Structural Materials Laboratory of Chicago and L. N. Edwards, then bridge engineer of the city of Toronto, has been along experimental and theoretical lines. The Hydro-Electric Power Commission of Ontario, however, has for some time been studying the theories with a view to their application to practical work, and as a result has developed a method of proportioning which is being used on all of the concrete placed by the Commission, to total over half a million yards in the next three years. Some opposition has been encountered in its introduction, but this has been more because the concrete mixtures have been drier than formerly than from opposition to the system itself. It is not only more scientific in its theoretical basis, but it is providing concretes of the quality specified, and doing this more economically than the old-time methods of proportioning.

The system is based on a very simple foundation built upon a combination of the theories of Prof. Abrams and Mr. Edwards. Prof. Abrams has noted as a result of his experiments that, within the range of workable concrete mixtures, the compressive strength of a concrete bears a definite relation to the ratio between the volume of water and the volume of cement contained in the mixture from which it was made. This water-cement ratio, as it is called, is simply a measure of the quality of the cement paste used to glue the particles of aggregate together. Abrams has shown that for any given set of conditions—same aggregates, same cement, same age of concrete, etc.—concretes of equal water-cement ratio have approximately equal strength regardless of their cement content so long as their mixtures are practicable and workable.

The experimental studies in the laboratories of the Hydro-Electric Power Commission of Ontario corroborate this and have further shown that the mixing water required to obtain concrete mixtures of constant mobility varies as the surface area of the aggregates used. This being so, it follows that to maintain constant strength and therefore a fixed ratio between water and cement, it is necessary to vary the cement also as the surface area. This agrees with Mr. Edwards' surface-area theory.

In practice, concrete has to fulfil two conditions: it must have a strength at least equal to that fixed by the design of the structure of which it forms a part and it must be sufficiently plastic to handle and place properly during construction. It is evident that the first condition defines the quality of cement paste or water-cement ratio of the mix and the second the ratio of cement and water to surface area. If the ratio of cement to surface area and the water-cement ratio is known for any desired strength and plasticity the water content of the mix is likewise fixed. Therefore in proportioning, the cement-area relation need only be considered.

The foregoing forms the skeleton upon which has been built the system now in practical use by the Hydro-Electric Power Commission of Ontario. For any proposed aggregate, tabular relations are experimentally established between strength and water-cement ratio and between cement content and surface area, for one degree of plasticity known as normal or 1.00 consistency. Then if the normal consistency is satisfactory for the particular work in hand, the cement content and water-cement ratio corresponding to the quality of concrete specified are read off the tables and the mixtures proportioned accordingly. If the normal consistency is not satisfactory the consistency is varied by *changing both the cement and water proportionately*, thus maintaining the proper water-cement ratio, until the desired workability is obtained.

How Surface Areas Are Found

Surface areas are determined by the same method as employed by Mr. Edwards in his original investigation. The aggregate is separated by means of testing sieves into its component sizes and the number of particles per unit weight of each size is obtained by count. The assumption is made that these particles are spheres. It is then possible from these counts and the specific gravity of the material to calculate for each size of separation the surface area of the average particle and hence the total surface area in a pound of particles. This information is tabulated as in Table I and put into the form of charts as in Figs. 1 and 2. In calculating the surface area of a particular aggregate it is necessary to sieve it into the same sizes of separation as those used in obtaining the above data. The percentages lying between adjacent sieves are translated as so many pounds of each size material in 100 lb. of aggregate. The surface area corresponding to the weight of each size is read from the surface-area chart or calculated from the tabulated data. The sum of the different values thus obtained is the surface area per 100 lb. of aggregate. This may be changed by simple calculation to surface area per cubic foot.

It has been found experimentally that the dust—that is, anything below the No. 150 sieve—is more comparable to the cement than to the aggregate and that where it does not exceed five per cent it can be entirely ignored both in calculating surface area and in subsequent proportioning.

The actual operation of the method is as follows:

When a piece of construction involving concrete is contemplated a combined field and laboratory investigation is first made to determine the most suitable and economical sources of supply for the necessary aggregates. The extent of this investigation depends on circumstances but usually it consists of reports on deposits, samples from those deposits and field and lab-

TABLE I SURFACE AREA PER 100 LB. FOR DIFFERENT SIZES OF SEPARATION OF SAND, GRAVEL AND CRUSHED STONE

Pass	Sieve No. Retained	Sand and Gravel Sq.Ft. per 100 Lb.	Crushed Stone Sq.Ft. per 100 Lb.
2½	1½	23.6	36
1½	1	42.7	62
1	¾	74.6	124
¾	½	130.0	163
½	No. 6	255	...
No. 6	10	437	...
10	20	875	...
20	35	1744	...
35	65	3490	...
65	150	6975	...

oratory tests of these samples to determine their quality. This work is undertaken as far as possible in advance of actual construction.

Once the source has been determined from which the aggregate is to be taken, a quantity of the material, usually from 3000 to 5000 lb., is shipped to the laboratory for detailed investigations into its concrete-making properties. The first study undertaken is to determine the mechanical analysis of the combined fine and coarse aggregate which will give the most economical mixture, considering both workability and economy of materials. The most economical mixture is one containing the lowest surface area per cubic foot of material which can be successfully handled and placed. These studies are checked in the laboratory by making concrete mixtures of different gradings and observing their mobility and flowing properties.

The quantities of concrete handled in the laboratory are too small to allow of their exhibiting the same characteristics as do large masses of concrete and hence the final decision as to what is a workable mix must be made in the field. Coincident with this work the necessary grain counts and calculations are made to obtain the surface area per pound of each size of these materials and these results are charted.

The next step in the laboratory investigation is to determine for these materials the relation between cement content at normal consistency, water-cement ratio and compressive strength. Using the combination of fine and coarse aggregate giving the grading already determined as most suitable, a series of tests is made in which the cement is proportioned according to the surface area of the aggregate. Water is added to give mixtures of the same mobility. Concrete test specimens are made from these mixtures and tested in compression. These tests establish the relation between compressive strength and cement content at the normal or test consistency and between compressive strength and water-cement ratio for all consistencies, for the relation between water-cement ratio and strength is independent of the consistency and if established for one consistency holds equally for all others. Typical results of such tests are given in Table II. Figs. 3 and 4 are plotted from these data and are representative of a large number of curves obtained in similar manner.

In proportioning cement by surface area the unit of measurement used is the lb. per 100 sq. ft. The number of different proportions in a series of tests depends upon circumstances. Where the work for which the tests are being carried out involves only a few thousand cubic yards of concrete, four sets of five specimens are made proportioned 1.5, 2.0, 2.5 and 3.0 lb. of cement per 100 sq. ft. of area and tested at 28 days. Where the yardage is considerable, six sets of ten specimens with a range of cement from 0.75 to 4.0 lb. per 100 sq. ft. of area are tested at both 28 and 90 days. Where the yardage is very large even more extensive investigations are warranted. In any case less than four sets are inadvisable and more are always to be recommended.

In proportioning water the simplest way is for the operator to add the water until, in his judgment, the mixture is of the required mobility. With an experi-

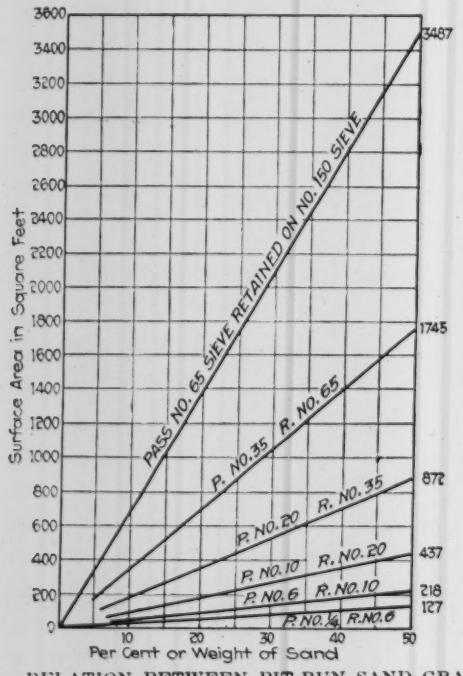

Surface Area in Square Feet
Per Cent or Weight of Sand
PASS NO. 65 SIEVE RETAINED ON NO. 150 SIEVE
P. NO. 35 R. NO. 65
P. NO. 20 R. NO. 35
P. NO. 10 R. NO. 20
P. NO. 6 R. NO. 10
P. NO. ¼ R. NO. 6
3487
1745
872
437
218
127

FIG. 1. RELATION BETWEEN PIT-RUN SAND GRADING AND SURFACE AREA

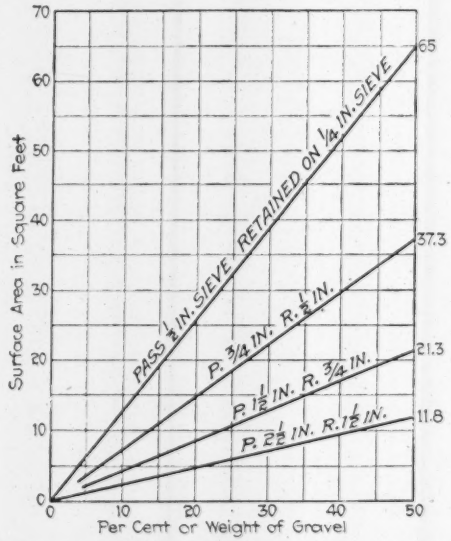

Surface Area in Square Feet
Per Cent or Weight of Gravel
PASS ½ IN. SIEVE RETAINED ON ¼ IN. SIEVE
P. ¾ IN. R. ½ IN.
P. 1½ IN. R. ¾ IN.
P. 2½ IN. R. 1½ IN.
65
37.3
21.3
11.8

FIG. 2. RELATION BETWEEN PIT-RUN GRAVEL GRADING AND SURFACE AREA

TABLE II. RELATION BETWEEN CEMENT CONTENT, WATER-CEMENT RATIO AND COMPRESSIVE STRENGTH

	Series IB-1						
Cement—Lb. per 100 sq.ft.	0.75	1.5	2.0	2.5	3.0	4.0	5.0
Water-cement ratio	1.994	1.118	0.915	0.780	0.697	0.590	0.522
Compressive strength, lb. per sq in	548	1337	1791	2290	2851	3426	4158

enced operator this method can be made to yield satisfactory results even with a wide range of cement ratios and differently graded aggregates. In the work of the Commission, however. a formula is used for determining the correct amount of water required to bring a mixture to the proper mobility. This formula is based on a theory as yet only partially established and its discussion is without the scope of this paper. It is not general in its application and its constants have to be determined for each different class of material. They are derived from the tests made when studying the relative mobility of the different combinations of aggregates. With this formula, mixtures have been obtained the mobility of which was so nearly equal that no difference could be detected by any means at our disposal.

The concrete specifications of the Commission provide for four classes of concrete designated A, B, C, and D. Class A concrete is required to be of such quality as to show a minimum compressive strength of 2500 lb. per sq. in. at the age of 28 days when tested in accordance with the standard methods of testing of the Commission. Classes B, C, and D are required to have minimum compressive strengths of 2000, 1500 and 1000 lb. per sq. in. respectively under the same conditions. This form of specification has been adopted because it is considered more logical to specify the property desired of the concrete than to give a formula for the mixing of its ingredients.

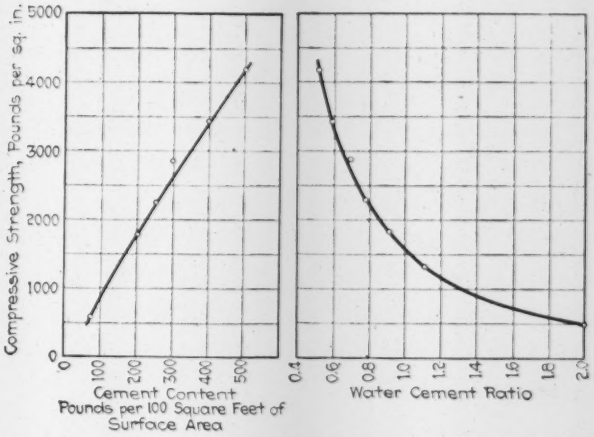
In designing concrete mixtures to fulfill these specifications it is customary to allow a margin of from 300 to 500 lb. per sq. in. to take care of field conditions. A 300 lb. margin should be ample, however, if the operations of proportioning and placing are subject to careful inspection. Allowing a 300 lb. margin of safety, the ratio of cement to surface area which corresponds to each of the above classes of concrete would, in the case of the materials used in the tests of Fig. 3, be those shown in Table III. These, however, hold only for concretes of the same plasticity as that used in the tests. As before noted, compressive strength depends on the water-cement ratio of the paste. From Fig. 3, therefore, is obtained the range of water-cement ratio

TABLE III. CEMENT RATIO AT NORMAL CONSISTENCY AND WATER-CEMENT RATIO CORRESPONDING TO CLASSES OF CONCRETE IN SPECIFICATIONS

Class	Minimum Specified Compressive Strength, Lbs. per Sq.In.	Cement Lbs. per 100 Sq.Ft. Surface Area, Normal Consistency	Range of Water Cement Ratio Min.	Max.
A	2500	3.18	0.68	0.74
B	2000	2.58	0.78	0.86
C	1500	2.08	0.91	1.04
D	1000	1.48	1.14	1.37

which corresponds to both the minimum compressive strengths specified for each class and to that minimum compressive strength plus its margin of safety. The former is the maximum water-cement ratio allowable and must never be exceeded if concrete of the proper quality is to be obtained. The latter is the water-cement ratio normally worked for. These minimum and normal water-cement ratios are likewise given in Table III.

By means of these tests and investigations all the data required for proportioning concrete mixtures are obtained. The next step is to apply these data to setting proportions in the field.



FIGS. 3 AND 4. CURVES ESTABLISHING RELATION BETWEEN COMPRESSIVE STRENGTH, WATER-CEMENT RATIO AND CEMENT CONTENT AT NORMAL CONSISTENCY

In the field the first step is to obtain the surface area per batch in order to proportion the cement. This requires, first a mechanical analysis of the different aggregates used, a determination of their weight per cubic foot and a knowledge of their moisture content and of the proportions in which the different aggregates are to be combined in the mix.

The proportions for the different aggregates are worked out using as a basis the data obtained by the laboratory in the preliminary studies of the most economical mixture. The aim is to get the leanest concrete which is workable, gives a good surface, has the requisite density and at the same time fulfills the requirements for water-cement ratio and hence for strength. Although the preliminary studies of the laboratory are of great value in obtaining this, the final proportions should actually be set in the field, for to some extent they depend on the type of structure being built, whether mass or reinforced, on the amount and spacing of the reinforcing, on whether the sections are thick or thin, on the maximum size of stone used and the quantity of this maximum size present in the coarse aggregate, on the consistency, on the quality of labor, etc.

The sieve analysis and other tests referred to are carried out by the field engineer with equipment supplied him for the purpose. The sieve analyses and weight per cubic foot determinations are performed similarly to those in the laboratory, except that the latter is made without drying the aggregate, as is laboratory practice. From the data of these tests and the surface area charts of Figs. 1 and 2 the surface area per 100 lb., or per cu. ft., and hence per batch, are determined.

The weight of cement required for normal or test consistency is found by multiplying the surface area per batch by the proper cement factor (Table III) for the class of concrete it is sought to obtain. This weight is usually given in terms of bags of cement. The quantity of gaging water is then calculated from the minimum water-cement ratio (Table III) corresponding to same class of concrete. In calculating the water, allowance must be made for moisture contained in the aggregate in its natural state. This has been found to be seldom less than two per cent, and is usually between

three and four per cent. This last is a safe figure to use except directly after a rain when six or eight per cent. moisture should be allowed for. It is better practice, where circumstances permit, to determine the moisture content of the aggregate by actual test but this is not always possible. Experience has shown that if these tests are made a few times under different weather conditions, the engineer can then judge the proper moisture corrections of his aggregate so closely that only occasionally check tests become necessary. Moisture tests do not have to be made upon the coarse aggregate unless it is mixed with considerable fine aggregate, as the amount present is negligible.

Add Both Water and Cement

If the normal or test consistency is too dry for the work in hand, cement and water in the same proportion are added until the required mobility is obtained. If the consistency is wetter than necessary the cement and water are reduced in the same manner. The new consistency is defined in terms of its relation to the normal or 1.00 consistency. In further proportioning in which the same mobility is desired, the cement content for normal consistency is multiplied by this consistency factor, that is, by 1.10, 0.90, etc., as the case may be, and the water proportioned to give a cement paste of the proper water-cement ratio.

Natural aggregates are subject to changes in their grading and it is therefore necessary to test them frequently and alter the proportions of the concrete mixtures to suit. This involves a repetition of the mechanical analyses and calculations for surface area described before. It is not usually necessary to change the combination of the aggregates except where the variation in the materials is considerable, as when, in using a mixture of bank sand and crushed stone, the percentage of gravel in the former changes from, say, 25 per cent. to 40 per cent. When such occurs and changes in the proportions of the aggregate are necessary, the combinations which give the nearest approximation to the ideal grading are determined as was done in fixing the original proportions.

Finally samples of the actual concrete produced are taken periodically, made into standard test cylinders and sent into the laboratory. It is our practice to take these directly from the forms, to take two or three samples at a time and to test these at 28 days. Samples are taken whenever it is necessary to change the proportions, and oftener if deemed advisable by the engineer in charge. Careful record is kept of the portion of the structure represented by the samples, the proportions used, the approximate water-cement ratio and all other pertinent data.

Certain features peculiar to the use of this method bear emphasis. If the contractor is required by the specification to produce concrete of definite quality, then it is evident that to do so he must use concrete mixtures having water-cement ratios not greater than those corresponding to the minimum requirements of the specification. Where this is insisted upon the question of the proper consistency to use under any given set of conditions is one that can be left to the contractor for solution. The wetter mixes require more cement, the drier more labor to handle and place. The contractor will balance these two factors and may be depended upon to use the consistency that is cheapest. This will almost always be found to be the driest consistency practicable for the work in question.

The method allows the use of bank-run aggregates or mixtures of these with crushed rock or gravel. The former are seldom, if ever, economical in cement, but their use is sometimes advisable where the size of the job or other consideration makes their treatment unprofitable. The Commission has regularly used a mixture of screened crushed rock and bank sand and gravel. This practice has been found entirely satisfactory and the mixtures used have been economical in cement and no trouble has been experienced with them in getting concretes of the required strength.

Under ordinary conditions the only changes in proportions to compensate for changes in the aggregate occur in the cement. This is the easiest material to handle; it is also the most expensive. Changes in the proportions of the aggregates usually involve a disruption of the system of handling materials, give rise to confusion among the workmen and increase the difficulty of inspection. Changes in the quantity of cement involve a change in the routine of only one man, whose intelligence is usually superior to that of the laborer handling the aggregate. The proportions are more easily checked and inspection is simplified.

Proportioning by the surface area method allows the use of a smaller margin of safety than is permissible when the proportions must cover a wide variation of materials. To take advantage of the economies in cement, possible where this smaller factor of safety can be used, it is necessary to proportion the cement more closely than is customary in the field. Splitting a bag of cement in half is as fine a division as is ordinarily considered feasible in practical work. Where small mixers are used this is not enough, and some provision should be made to further subdivide a bag. An arrangement is not hard to devise and saves its cost many times over. If a quarter of a bag of cement can be saved on each one-half yard batch in a day's run of 160 cu.yd., it means a saving of 40 bags, or from $25 to $40, which will pay handsomely for the extra labor and equipment involved. On large mixers the saving does not usually warrant the extra trouble and expense. The Commission has under consideration proportioning the cement entirely by weight; eliminating, wherever possible, the bag as a unit of measurement.

Cost of Studies Moderate

The cost of the investigations is moderate. It is hardly debatable that an investigation of the concrete materials should be made prior to any work of importance. Experience has too often shown the danger of neglecting this precaution. Few will quarrel with the statement that tests should be made of the concrete produced. These precautionary measures are common to all methods, only here the laboratory investigations are carried out differently. Our experience, which covers the usual methods as well as those described here, has demonstrated that the studies and investigations for the latter cost less and yield more valuable information than those for the former. Their cost runs from $400 to $1000, depending on the size of the job, its distance from, and the experience and organization of the laboratory making the tests. These costs are moderate, considering the benefits to be gained. We are making an endeavor to develop approximate meth-

ods for use on the smallest jobs of a few hundred cubic yards or less. We believe it will soon be possible to make such studies as are necessary for these at a cost of from $50 to $75, and still retain the essential features of the method. It will usually be found that the cost of such investigations as are required will be offset by the savings effected by the more accurate proportioning possible.

Method Good in Competition

It will be of interest here to cite a recent experience of the Commission. On a job upon which the surface-area method is being regularly used a structure is also being built for an outside firm using methods specified by their engineers. On the same job another structure in which concrete of the same quality is called for is being built, using the surface-area method. Materials for the two structures are from the same sources and are mixed and placed with similar equipment. The results, shown in Table IV, from seven consecutive tests of field concrete specimens, some of which were

TABLE IV

Cylinder No.	Class of Concrete	Proportions	Compressive Strength, Lbs. per Sq.In.	Method
90	B	1:2:4	2000	H. E. P. C.
91	B	1:2:4	2480	H. E. P. C.
92	B	1:2:4	1960	Foreign
93	B	1:2:4	1470	Foreign
94	B	1:2:4	1800	Foreign
95	B	1:2:4	1510	Foreign
96	B	1:2½:5	2090	H. E. P. C.

from each of the jobs and which represent concrete placed simultaneously, illustrate the kind of results obtainable with the two methods.

In the pouring represented by the last specimen the mix had been changed to a 1 : 2.5 : 5, yet the quality and mobility of the concrete were maintained at the standard desired.

The surface area method as here described has been found to take well in the field. The laboratory studies involved in its use are cheaper than those required for other methods and obtain information of wider application. The method has been found to give a means of estimating the relative economy of different aggregates because two factors, workability and strength, which were formerly variable have now been reduced to constants. The success so far obtained in its use has been so encouraging that it is now expected it will be used on all work undertaken in future by the Commission.

Work of the Los Angeles Municipal Repair Shop

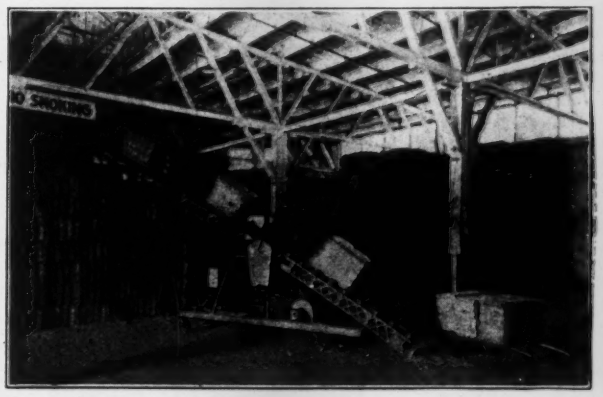
The municipal shop operated by the Board of Public Works of Los Angeles, Calif., does repair work on the following city-owned equipment, according to the annual report of the engineering department of Los Angeles for the year which ended June 30, 1919: Nineteen steam fire engines; 14 motor-driven fire engines; 40 hose, ladder and other fire-department trucks; 43 motor trucks used by other city departments; 105 passenger automobiles; 46 motorcycles; three asphalt pavement surface heaters; a municipal asphalt plant; an oil-heating plant; two rock-crushing plants; and miscellaneous equipment. During the fiscal year, 4504 jobs were completed, aggregating $120,289 in cost. A detailed card record is maintained for each automobile repaired. These repair data for the year covered are given in tabular form.

Freight-Handling Equipment at the Port of Seattle

Public Operations Tend To Encourage Experiment and Develop Labor-Saving and Freight-Handling Devices

By George F. Nicholson
Chief Engineer, Port of Seattle

SEVEN years ago the Port of Seattle entered upon an extensive program of port improvements, and established the policy of sparing no reasonable expense or effort in providing the very best facilities and equipment for the class of business expected. Under this policy a great deal of experimental work with freight-handling and labor-saving devices has been carried on, and the port has been provided with more and better mechanical freight-handling equipment for handling



CONVEYORS FOR STACKING BALED HAY AND SACKED WHEAT

miscellaneous cargoes, the writer believes, than any other port in the United States or Canada. This conclusion was reached after the writer visited last autumn all Atlantic, Gulf and Pacific ports.

Public operation has apparent advantages over private in the matter of labor-saving and freight-handling devices. Under public control, when a labor-saving device is found to be an improvement on methods previously employed, it is provided and put in service, and employees can be encouraged to work out new plans or to suggest improvements on equipment in use. In contrast with this, the private dock owner is slow in taking up the matter of providing new mechanical equipment. As an illustration, when the Port of Seattle completed the Stacy St. pier, two electric tractors and a number of trailers were bought and assigned to it for handling cased salmon.

Up to that time no tractors had been used for work on the Seattle waterfront. However, many visitors came to study the operation of the new tractors, and within three weeks four electric tractors were on order for privately owned docks in the same port. This is not an isolated instance. It typifies the willingness to pioneer which has meant progress.

The development of the vegetable oil handling facilities at Seattle was described in *Engineering News-Record* of July 31, 1919, p. 204, and the portable stacking elevator, which solved the gunny-bale problem, in the issue of Nov. 13-20, 1919, p. 855.

Where the leasing system is in vogue, as in San Francisco, New York and other ports, the harbor board provides the facilities such as docks and warehouses and places upon the lessee the responsibility for providing handling equipment. Under such conditions, the writer believes, the lessee will be very slow to purchase handling equipment. The Port of New Orleans and the Public Dock Commission of Portland have already realized this, and their policy is now to work gradually into the publicly operated system.

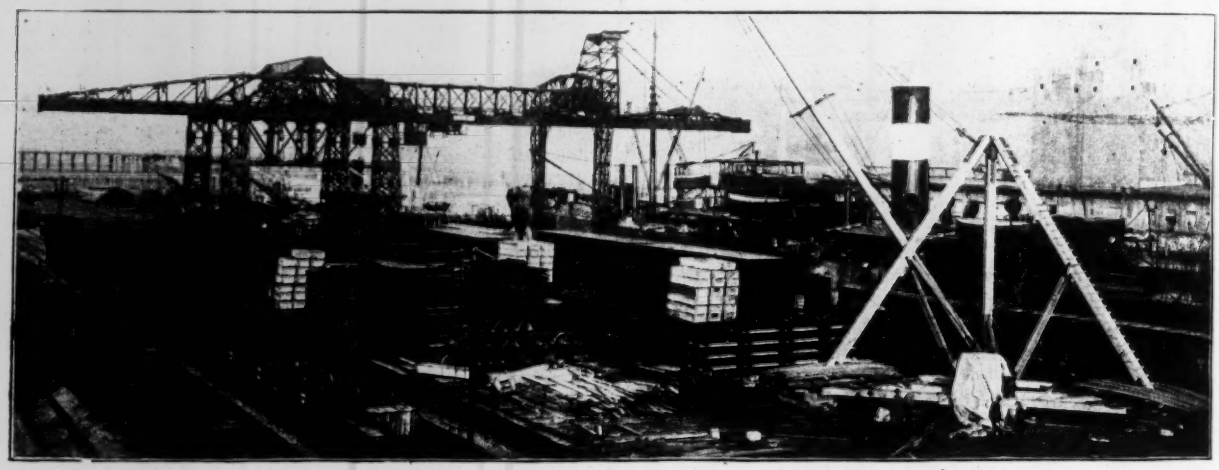
The mechanical handling equipment of the Port of Seattle as now installed is valued at approximately $950,000. This, of course, does not include sprinkler and lighting systems or water-supply. The freight-handling equipment may be divided into two classes, heavy and light. The heavy equipment is used principally for handling export cargo consisting chiefly of iron and steel and lumber. This includes gantry cranes, portable locomotive cranes, stiff-leg derricks and a 100-ton shear-leg derrick. It is also contemplated to install a 100-ton revolving hammerhead crane on the new pier B, now under construction at Smith's Cove. This heavy equipment has been found indispensable in the export trade, and we do not know of any new equipment that could handle this class of commodities with more dispatch and economy.

The other class of equipment is the light equipment for handling the import cargo, which consists chiefly of large and small boxed, baled and sacked goods. This equipment includes inclined power conveyors, portable electric stacking elevators, stationary electric elevators, electric tractors with the necessary trailer, and other similar devices.

In case of sacked goods, such as wheat, sugar, beans, rice, and also in the case of baled hay and similar light bales, inclined power conveyors are used almost exclusively, and are operated in the same manner as the stacking elevators—that is, the inclined conveyor is placed at the pile and the truckers bring their goods to it. The crux of the problem of economically handling baled and sacked freight is in the stacking, because it is in that phase of the handling that the labor cost increases most rapidly. It is hard to improve on the two-wheel truck for short hauls, and it is because of this that many proposed mechanical handling schemes fail—that is, they attempt to carry miscellaneous freight from the ship's side to the interior of the shed. It will be found that even with the high cost of labor on the short hauls the two-wheel truck is cheaper.

A great deal has been said about the use of semi-portal cranes along the shed, and monorail or overhead rail systems for transit inside the sheds. The writer has come to the conclusion, however, that on account of the great number of markings on import cargoes coming into Seattle and the great amount of sorting necessary, the overhead monorail system would fail. For the freight that comes in sacks, boxes or bales, the use of light portable stacking equipment inside the shed served by two-wheel trucks seems to be the most economical and satisfactory method thus far developed.

A very considerable saving in the cost of handling freight is possible where transfer can be made between railroad cars and ships, or vice versa. It is essential to have two shipside tracks on the wharf for this operation. A very large proportion of the export cargo is handled in this manner in Seattle, and it will be found that the ship's tackle in this direct loading is as efficient as an expensive dock crane.



TRANSFERRING FREIGHT AT SMITH'S COVE PIER, SEATTLE, WITH 100-TON GANTRY CRANE

Seattle has found it desirable to use a special type of elevator for handling freight from one floor level to another. The last one installed has a capacity of nine tons and a 10 x 24-ft. platform which will accommodate six trailers at one time. In connection with the new Smith's Cove Terminal the installation of a much larger elevator, with an 11 x 40-ft. platform, is being considered. This would accommodate two tractor trains of five trailers each, or a total of 10 trailers, the tractors being used on either floor for hauling the trailers between the elevator and the pile.

Ship conveyors for the loading and unloading of ships are considered a most essential part of the port's equipment. For the accommodation of the second floor of the two-story transit sheds, an outside portable platform, moved to any location alongside the shed, is found very useful. With this equipment it is possible to deliver freight, with the aid of the ship's tackle, direct to the second-floor level with as much ease as it could be unloaded on the first-floor wharf. In some cases, at extreme low tide, it has been found impossible to reach the second-floor platforms with the short booms

in use on some of the ships. This difficulty can be overcome by replacing the shorter booms with 50-ft. and 60-ft. booms, the latter being kept as spare booms on the wharf for use in such emergencies.

The installation of loading-out chutes, running from the second-floor level to the cars on depressed tracks or outside platform surface tracks and also the ship's hold on the water side, is important. With these inclined gravity chutes it is possible to load out goods from the second floor into cars very cheaply, and in actual practice it has been demonstrated that some sacked freight, for shipment by rail, can be loaded into cars more economically by use of gravity chutes from the second floor than it could have been trucked into cars from the first floor. By hinging gravity chutes to the portable second-floor platforms referred to, the result is, in effect, portable chutes which may be spotted in front of any car door in a long string of railroad cars located on the outside wharf tracks.

When heavy freights, such as iron, steel and lumber, are being handled over the open-wharf section, the locomotive cranes are kept in almost constant operation. They are used in loading and unloading ships and also in assembling cargo of this character on the wharf in order to expedite clearing a vessel after it has docked. Being portable, these cranes when not in operation can be used in connection with the piling of heavy materials on open storage property in the rear of terminals.

The 100-ton structural-steel shear-leg derrick on the Smith's Cove pier, shown in a view herewith, has been a most valuable piece of equipment for making heavy lifts and has paid for itself time and again, but it can be used to advantage only when heavy lifts are to be made direct from railroad car to ship or vice versa. If it is necessary to store a heavy piece of freight on the wharf it must be loaded on a railroad car with the derrick and then taken off again by some other means. A revolving crane would eliminate this trouble, and heavy loads could be placed for storage at any location on the wharf within the radius of the crane.

In equipping pier B, which is being built alongside the present Smith's Cove pier (pier A) the previous experience of the port will be of advantage in selecting freight-handling equipment. For example, instead of a shear-leg derrick, such as the one just mentioned, the next pier will have a 100-ton stationary revolving crane. There will also be two 10-ton portable gantry cranes on the open wharves of this new pier. These gantry cranes, although specialized equipment, resemble an elevated locomotive crane that operates back and forth the full width of the open wharf on a gantry bridge which travels the full length of the wharf.

It will be possible with this equipment to assemble cargo on the open wharf or to transfer it from the cars situated on any track on the pier. Such cargo can then be moved from the wharf to the ship's hold, or it will be possible to transfer cargo, from cars on the depressed tracks in the center of the pier, direct to the ship, without rehandling. This type of equipment will be a great improvement over the gantry crane in service on pier A, which, it must be admitted, has not proved entirely satisfactory. There are two serious drawbacks in the operation of the pier A gantry, as follows: (1) As it is of the underslung type of gantry crane, it has been difficult to handle long pieces of lumber and long bar-steel, because the bracing connecting the legs that support the gantry bridge interfere with the transfer of this freight from one side of the wharf to the other or from the wharf to the ship; (2) the shipside leg of the gantry crane is located so close to the face of the dock that it is impossible to move the gantry bridge along the wharf at certain stages of high tide, on account of the interference of the gantry bridge with the ship's rigging.

New Specifications for Public Health Officers

Abstract of Paper Read Before Sanitary Engineering Section of American Public Health Association Convention, October 27-30, 1919

By Morris Knowles and Maurice R. Scharff
Consulting Engineers, Pittsburgh

ABOUT seven years ago the authors presented before the Sanitary Engineering Section of the American Public Health Association at Washington, D. C., a paper entitled "Public Health Service—Not a Medical Monopoly." This paper showed that existing state laws required 172 out of 298 members of state boards of health, and 32 out of 46 state executive health officers or commissioners of health, to be physicians; and it upheld the thesis that the degree of Doctor of Medicine was not the only necessary, or indeed the best, qualification for a health executive, and that the cause of public health would be advanced if every state would remove the restriction limiting public health service to the medical or any other single profession, requiring instead that health officers should be trained and experienced in sanitary science and public health and qualified by administrative ability and judgment to perform the manifold functions of the modern public health officer.

Let us state at the beginning that our thesis was not in any sense that a medical man may not be well fitted to fill public health positions, or that a sanitary engineering course is better preparation for such work than a medical one. In fact, we would go so far as to say that a doctor of medicine who had had thorough training in sanitation and public health and who possessed the necessary administrative ability and judgment would probably be better qualified than a member of any other profession with similar education to fill such a position. What we did emphasize was that special training in public health, and administrative ability and experience, were all more essential than the medical degree. In other words, as Prof. C-E. A. Winslow put it in the discussion of the 1912 paper, we would consider a man with both kinds of training preferable to one with either kind alone; but would much prefer a man who knew public health and not medicine to one who knew medicine and not public health.

Since 1912 a number of developments have occurred which appear to the writers to justify the conclusion that there is a general agreement upon these "new specifications for health officers."

Crystallization of Opinion—Numerous expressions of opinion could be quoted from public health literature since 1912 to show the growth and development of the opinion that the ideal health officer must fulfill the new specifications. Dr. W. S. Rankin said in his paper be-

fore the American Public Health Association convention at Jacksonville, Dec. 3, 1914:

> There is a prevalent error especially pronounced and dangerous to controvert in medical assemblages to the effect that the average physician will make, on his appointment or election to a health office, an efficient health officer. There is just as much sense in claiming that the average physician is a dermatologist, a pathologist, an ophthalmologist, a surgeon or any other specialist as that the average physician is a health officer whenever an undiscriminating public puts him where a health officer is supposed to be. The efficient health officer is a specialist—as much a specialist as is the surgeon or the ophthalmologist.

Assistant Surgeon General W. C. Rucker, of the U. S. Public Health Service, said in his paper on "A Program of Public Health for Cities" before the Cincinnati convention of the American Public Health Association, Oct. 24, 1916:

> Unfortunately, health has been considered in the past only as a medical problem, and the pendulum has been enthusiastically swung so far that health is almost regarded as an artificial state to be achieved and maintained solely through the interposition of medical safeguards. With entire consistency, health wardenship of cities has been committed solely to physicians, those who by training have been taught to consider the pathological in human life, the symptomatology and evidences of disease rather than the great basic, underlying essential factors which enter into and are the vital part in the creation, spread and perpetuation of sickness. Expert knowledge of disease is absolutely necessary for the work of health departments, but cannot be the foundation of a broad, municipal health policy.

In the discussion of this paper, Dr. J. N. Hurty said:

> We must all agree with Dr. Rucker that in the past public health has been considered as too strictly a medical matter or a physician's problem. We have all come to recognize that efficient health wardenship requires something more than a knowledge of the diagnosis and the treatment of disease.

And in the same discussion, Dr. Henry F. Vaughan said:

> Dr. Rucker has stated that health in the past has been considered solely as a medical problem, as an artificial state to be achieved and maintained solely through the interposition of medical safeguards. It seems to me that there are undoubtedly many phases of public health administration which can be handled more effectively and more efficiently by the business man or the engineer or by others.

Public Health Education—In 1913 the School of Public Health of Harvard University and the Massachusetts Institute of Technology was instituted. Other schools have followed the same line of development, and in 1918 Prof. Eugene C. Howe (*American Journal of Public Health*, Vol. VIII, p. 600) reviewed the courses of twenty institutions in the United States and Canada conducting special professional courses in public health, leading to degrees, certificates or diplomas in this subject. Among those institutions might be mentioned New York University, Johns Hopkins University, Ohio State University, Tulane University, Universities of Colorado, Pennsylvania and Wisconsin, Yale University, etc. It is no longer necessary, therefore, to employ sanitary engineers as health officers, as was formerly the case, because they were the only men available with a reasonable degree of special training in sanitary science and public health. The supply of trained health officers and their assistants, however, is still deficient, and the facilities for training of this kind should be increased and improved.

Legislation—Since 1912 at least two of the states have improved their public health legislation by incorporating into law the new specifications for health officers. Thus, Ohio, which formerly had a State Board of Health of seven, of which the Attorney General was an ex officio member, and a state health officer for whom no professional requirements were specified, passed a law in 1917 providing for a Commissioner of Health who must be "a physician skilled in sanitary science," and for a Board of Health to consist of the Commissioner and four other members, "at least two of whom must be physicians with training and experience in sanitary science." Still more recently, in 1919, New Mexico passed a law providing for a State Board of Health of three persons, not more than one of whom shall be a licensed physician; and a Commissioner, to be appointed by the State Board of Health, and who must be "a person having experience and special training in sanitary science and public health administration."

Sanitary Corps of the Army—Some of the most interesting examples of recent recognition of the necessity of securing health executives from outside the ranks of the medical profession have been afforded by our experience in the great war, and one of the best of these is found in the creation of the Sanitary Corps of the Army.

Paragraph 1386 of the Army regulations describes the duties of the Medical Department of the Army as follows:

> The Medical Department is charged with the duty of investigating the sanitary condition of the Army and making recommendations in reference thereto, of advising with reference to the location of permanent camps and posts, the adoption of systems of water supply and purification and the disposal of waste, with the duty of caring for the sick and wounded, making physical examination of officers and enlisted men, the management and control of military hospitals, the recruitment, inspection and control of the enlisted force of the medical department and of the nurse corps, and furnishing all medical and hospital supplies except for public animals.

The qualifications required of officers commissioned in this corps are that they shall be physicians, of age 21 to 32, and graduates of a reputable medical college. The requirements for a commission in the Medical Reserve Corps are that the applicant shall be a reputable physician (M.D.), in good standing in the community, in the active practice of his profession, licensed to practice medicine in the state where he resides, between 22 and 55 years of age, a citizen of the United States, and physically and professionally qualified.

When these qualifications are compared with the duties quoted above from the Army regulations, it will be easy to understand why, at the beginning of the war in 1917, it was recognized that these specifications were not complete for the officers required to fulfill these functions, and the Sanitary Corps of the Army was instituted. The qualifications required by the order creating this corps were as follows:

> The officers of said corps will be provided by assigning officers of the Medical Reserve Corps thereto, or by the appointment of citizens of the United States who are found under regulations established by the Secretary of War to possess especial skill in sanitation, in sanitary engineering, in bacteriology or other sciences related to sanitation and preventive medicine, or who possess other knowledge of special advantage to the Medical Department.

The sanitary engineers, bacteriologists and chemists

of the Sanitary Corps rendered signal service in connection with the protection of the health of our armies in camps and cantonments in America, and in France. Unfortunately, however, it is understood that provision has not been made either to continue the Sanitary Corps as a permanent part of the Army, or to provide a reserve in which the experience gained by this corps during the war may be conserved for future emergencies. The discrepancy between the functions to be performed by the Medical Corps and the Medical Reserve Corps and the qualifications required of their members is as great today as it was at the beginning of the war in 1917.

U. S. Public Health Service—A somewhat analogous situation exists with respect to officers commissioned in the U. S. Public Health Service. To obtain a commission in this organization, an applicant must be a citizen of the United States, a graduate of a reputable medical college with one year's experience in a hospital or two years' private practice of medicine. These requirements have not changed substantially since the service was known as the Marine Hospital Service. Meanwhile, the Public Health Service has extended its activities to include a wide range of sanitary work; and since 1912 it has been specifically authorized by law to "study and investigate the diseases of man and the conditions influencing the propagation and spread thereof, including sanitation and sewage, and the pollution, either directly or indirectly, of the navigable streams and lakes of the United States." During the war, a vast extension of this sanitary work took place, covering the sanitation of extra-cantonment zones, extensive investigations of industrial hygiene, and assistance and advice on many sanitary engineering problems of water-supply, sewage disposal, etc. (see "War Activities of the U. S. Public Health Service," by Benjamin F. Warren, assistant surgeon general, and Charles F. Bolduan, chief of the Section of Public Health Education, U. S. Public Health Service).

It is of course true that, even prior to 1912, the Service employed certain pharmacists, technical assistants, etc., and that later, but prior to the war, the new work embarked upon required the addition of sanitary engineers, chemists, bacteriologists and other non-commissioned sanitary assistants. It remained for the war, however, to bring out the inadequacy of the commissioned personnel to assume responsible charge of the sanitary work of the Service in such an emergency. At the Conference of State and Territorial Health Officials, held April 30 to May 3, 1917, therefore, resolutions were adopted calling for the creation of a Public Health Reserve; and although the resultant legislation met with many vicissitudes in Congress, it was finally passed on October 27, 1918. This measure provided for the creation of a Public Health Reserve, and that:

"The President alone shall be authorized to appoint and commission in the said reserve such citizens as, upon examination prescribed by the President, shall be found physically, mentally and morally qualified to hold such commissions."

The personnel of this reserve was assembled long prior to the enactment of the legislation authorizing commissions, and this force, supplemented by units drawn from the Sanitary Service Bureau of the American Red Cross, permitted the Public Health Service to play an invaluable part in protecting the health, both of our troops and of the civilian population, under the unusually difficult conditions created by the war.

Fortunately, the life of the Public Health Reserve was not limited to the duration of the war, as the enabling measure provided that "said commission shall be in force for a period of five years, unless sooner terminated in the discretion of the President." And there is great promise in the existence of this trained body of sanitarians, ready for call in any national emergency—especially as the after-the-war program of the Service (see Supplement No. 35 to the "Public Health Reports") proposes to provide the members with opportunities for intensive training in public health for short periods at stated intervals, and also to order members of the reserve to active duty from time to time to participate in important field work.

Public Health Service Commissions

The provision of this reserve, however, does not completely meet the needs of the situation. The work of the Public Health Service in the future will be in larger and larger proportion devoted to sanitation, and in less and less measure restricted to the original work of the Marine Hospital Service for which the qualifications for permanent commissions were designed. One cannot but be impressed with this fact in examining the after-the-war program to which reference has been made above. It is proposed to carry out this program by the cooperation of Federal, state and local health authorities, and the Federal-aid extension principle is recommended. Among the subjects included in the program are industrial hygiene, rural hygiene, prevention of diseases of infancy and childhood, surveys of water-supplies, introduction and extension of methods of water purification, pasteurization of milk supplies, inspection of production and distribution of milk and milk products, extension of water carriage sewerage systems, establishment of standards of permissible pollution of streams, lakes and rivers used for water-supplies, malaria prevention, drainage, control of venereal disease and of tuberculosis, sanitary supervision of railways, enactment of proper building ordinances and sanitary supervision of housing, promulgation of standards for sewerage and sewage disposal, standard specifications for safe water and water purification, etc.

The mere enumeration of these subjects seems to the writers to suggest the desirability of revising the requirements for commissions in the Public Health Service, and of making provision in the permanent commissioned personnel for sanitarians whose training and experience qualify them especially for the work to be done.

Conclusion

The proposals brought forward in this paper may be summarized as follows:

1. The new specifications for health officers require that such officers be qualified, trained and experienced in sanitation, public health and public health administration.

2. A medical degree is not a satisfactory substitute for the requirements of this new specification, but it is a desirable, though not a necessary supplement thereto.

3. The cause of public health would be advanced if this new specification were incorporated in national,

state and municipal laws relating to the appointment or commissioning of health executives.

4. A permanent Sanitary Corps, and a Sanitary Reserve Corps, the members of which conformed to the specifications outlined above, would be a desirable addition to our Army.

5. The Public Health Reserve is a real accomplishment, to be developed and supported in every possible way. In addition, the commissioning of sanitarians in the Public Health Service itself would contribute to the important sanitary work which that Service will, in future, be called upon to do.

Big Spoil Dump To Cover 200 Acres Maximum Depth of 60 Feet

Excavation From Queenstown-Chippawa Canal To Total 15,000,000 Cubic Yards Being Transported to Dump in Electric Trains

PRACTICALLY all of the excavation from the Queenston-Chippawa power canal now being built by the Ontario Hydro-electric Power Commission around Niagara Falls had to be wasted. At one place a deep gorge crosses the line of the canal, and the nearby excavation to the amount of 1,500,000 yd. is being used to fill the approach gulleys, but most of the remainder of the dry cutting, to the amount of 15,000,000 cu.yd., is being spoiled in a dump which is merely a dump to get rid of the material.

There is in all about 10,000,000 cu.yd. of dry-earth excavation on the canal, but about 1,000,000 yd. of this will go to the small dumps. Rock excavation will total 4,700,000 cu.yd., in place of which 500,000 yd. will be used for concrete aggregate and 500,000 yd. for riprap, leaving 3,500,000 for the main dump and 200,000 to other dumps. As the rock will expand about 180% in breaking up and dumping, the big dump will have to take some 6,300,000 cu.yd. of broken rock.

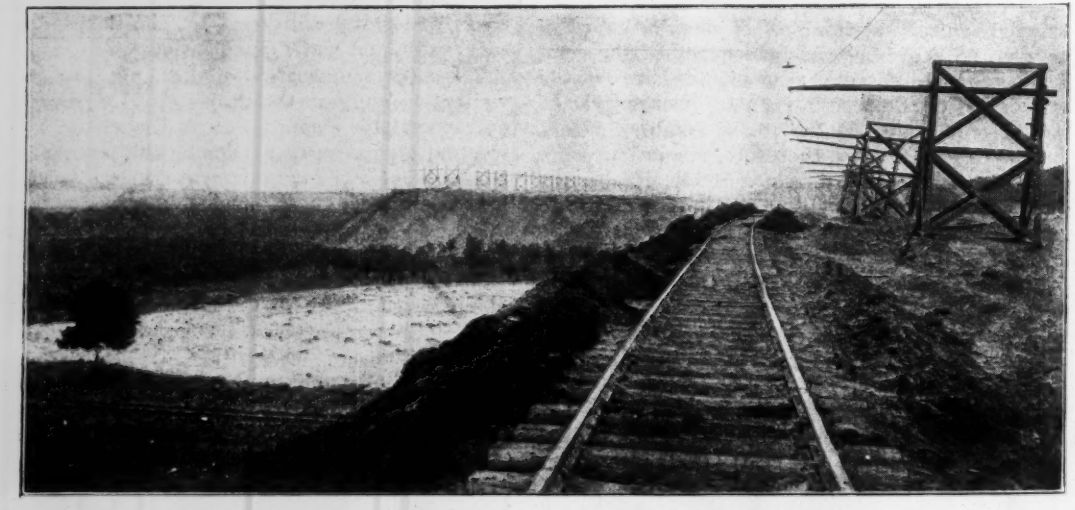
This spoil dump is located about two miles to the northwest of about the middle of the canal, on property which was formerly a prosperous farm and orchard. About 240 acres was purchased for the purpose, but only 200 will be filled, according to present plans. The average fill over this entire area will be about 46 ft. with a maximum fill of 60 feet.

The fill is reached by a double-track spur of the construction railway which parallels the whole canal. This

DUMPING STONE FROM THE CENTER TRESTLE

is a double-track standard-gage road of a type quite suitable for permanent way, although there are no present plans for its use beyond the construction period. It is laid with 70 and 85-lb. rail on well ballasted track, with a maximum grade of 1%, compensated. The whole line is electrified, the dump-car trains being drawn by 50-ton electric locomotives.

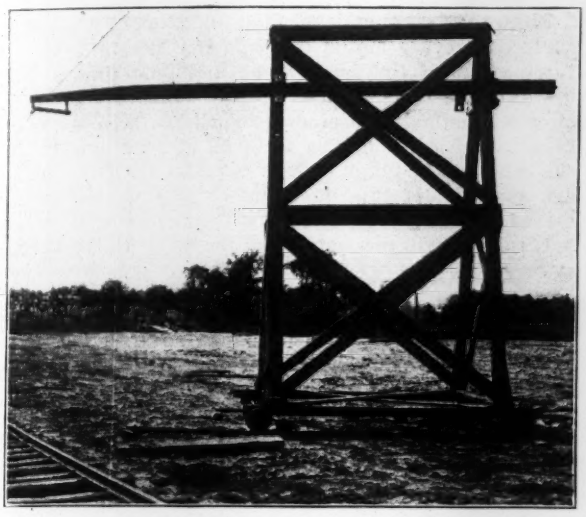
Throughout the line, the trolley wires are offset 7 ft. from the center line of the track, to permit the loading of dump cars and for clearance of the excavating



LOOKING ACROSS THE 15,000,000 YARD DUMP OF THE QUEENSTON-CHIPPAWA POWER CANAL

machines. On the dump, where the fill is moving from time to time, the trolleys are carried on portable frames, shown in the accompanying view. These timber frames, with outriggers for the trolley supports, are mounted on flanged wheels, which run on short sections of track, set up on the filled side of the tracks on which the dump trains run. As the fill progresses and the filling tracks need to be shifted, the portable frames are moved accordingly.

The railroad enters the trapezoidal shaped dump area at one corner, from which the dumping tracks fan out over the site. At first a trestle was built well out into the middle of the area and the fill started from it. On



PORTABLE TROLLEY FRAMES AT WHIRLPOOL FILL

this trestle fixed trolley poles were used. In addition, the railway was continued around a hill at one side of the area, and end-dump spurs run out at intervals therefrom. Filling is then continued by shifting tracks from the center fill or the spurs, and side dumping. In this way a number of dumps are maintained sufficient to take care, without train interference, of all the spoil delivered.

At present about 24,000 cu.yd. of excavation—mixed rock and earth—is being delivered every 20-hour day. This requires about 300 trains per day of a maximum 10-car make-up. The cars are 16-yd. and 20-yd. capacity. The dry cut canal is nine miles long, and the two-mile dump spur takes off about six miles from the upper end of the canal.

The Queenston-Chippawa Canal is being built by force account under the direction of F. A. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario, with H. G. Acres, hydraulic engineer of the commission, and J. B. Goodwin, works engineer, in immediate charge.

Cost of Holding Vessel in Port

An analysis of shipping costs made by the United States Shipping Board, says W. S. Meriwether of the board's information bureau, shows that the average daily cost of keeping a vessel in port exceeds $3000. The figures were made up for a 10,000-ton vessel. Because these port costs are so high, quicker turnaround of vessels is counted on to reduce cost of ocean carriage.

New Port and Shipping Statistics

DURING the war there was organized in the United States Shipping Board a branch termed the Port Facilities Commission, made up mainly of officers of the Army and Navy, with Maj. Gen. W. M. Black, U.S.A., as chairman, Rear Admiral H. H. Rousseau, U.S.N., vice-chairman, and Capt. F. T. Chambers, U.S.N., chief engineer. The commission has from time to time issued bulletins giving statistics of American ports, but it has collected a considerable quantity of such statistics which it has not been possible so far to have published. For the present, apparently, the commission will not be able to do very much active work, inasmuch as it has now been put entirely on an advisory basis, with the personnel reduced to the lowest degree. It is, however, willing and anxious to give consideration to any questions regarding port and harbor facilities in this country which may be directed to it. Meanwhile, there are available two documents, just published, which should be of considerable use to engineers interested in shipping.

These are the 68 pages of testimony in the hearings before the Committee on Merchant Marine and Fisheries in the House of Representatives, which includes the statements regarding the Shipping Board's interest in floating dry docks and a supplementary series of tabulations of shipping in the past generation. These are published as a part of the committee's inquiry into the operations of the United States Shipping Board, and should be available from the House of Representatives document room. The charts of shipping are entitled "Charts Showing Progressive Growth in Size of the World's Vessel Tonnage, 500 Tons Gross and Over, According to Classes of Tonnage, Length, Width, and Deep-Load Draft by Quinquennial Periods 1859 to 1918, and Analyses Thereof." In the charts are included graphic statistics of the coffee movement from Brazil to various parts of the states, forming one of a possible great number of similar analyses of various imports. There are also given the number and gross registered tonnage of all steamers afloat, total entrances of steamers in ports in this country, total number and length of dry-dock facilities, 1910-1917, gross registered tonnage of steamers afloat, distribution by states and commodities of agricultural products, distribution of textile manufactures and principal mining products. The remaining charts are devoted to the comparative technical statistics of war shipments. The second publication which is available is entitled "English Port Facilities," by Capt. F. T. Chambers. Captain Chambers made a trip to England during the war, and had exceptional facilities to gather full statistics of all of the English ports and harbors. The result is included in a large volume with a greater number of charts, maps, and details of English shipping terminal facilities than have ever been published before in this country.

Construction Corporation's Share of 1917 Taxes

Corporations engaged in construction paid income and excess-profit taxes during 1917 to the extent of $29,725,220, according to a compilation recently received by the Bureau of Internal Revenue. The total tax collected from corporations was $2,142,445,769. Of that amount 62% was paid by manufacturing corporations. Merchandising corporations paid 15% of the total. Mining corporations paid $212,365,019.

Light Bituminous Treatment for Macadam Roads

Thin Coatings Better Than Building Up Heavy Mats —Heavy Traffic Maintained at Moderate Costs—Tar Used

By Chester A. Hogentogler
Borough Engineer, Columbia, Penn.

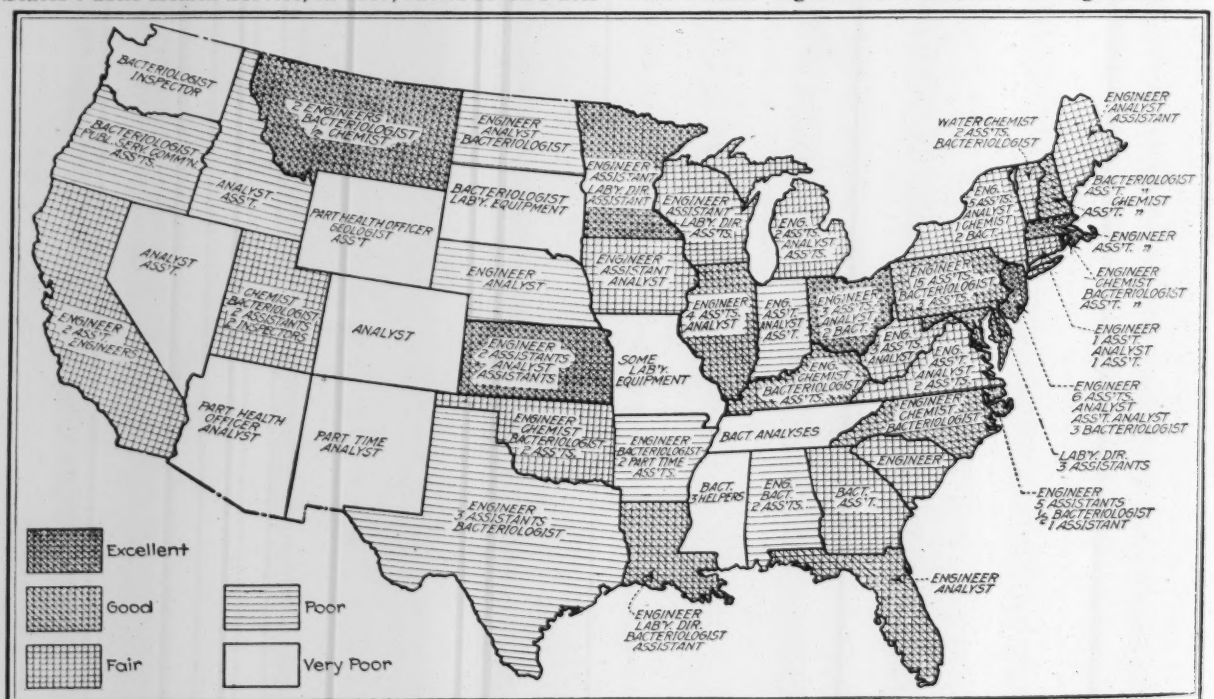
SUCCESS in the preservation of macadam roads at Columbia, Penn., has been attained by the application of light treatments of bituminous material of high penetration. Low-penetration materials having a tendency to build up heavy mats have not been found satisfactory or economical. The manner in which these treated roads have supported heavy traffic, with moderate maintenance charges, is of interest as showing how many of the advantages offered by higher-priced pavements can be obtained without excessive cost. Tar has been found to be preferable as a binding material in this type of work.

Generally speaking, treatments of this character are divided into three classes, according to the materials used and the results obtained. In the first class are those in which heavy bituminous materials with little or no penetrative power are applied, usually hot, and covered with a layer of stone chips or slag. The result is a heavy mat or carpet with little or no bond to the original macadam surface. In the second class are those treatments in which lightly penetrative materials are applied first to the original surface, and afterward the heavier binders are applied and covered with chips or slag. The result in this case is also a heavy mat or carpet with variable adhesion to the original surface. The third class consists of those treatments in which bituminous materials of highly penetrative, binding and hardening power are applied, usually cold, and covered with a light layer of sand to prevent tracking.

Since the first step in the disintegration of a macadam surface carrying motor traffic is the loosening up and forcing out of the small stone and dust binder from between the larger stones of the wearing course, the simplest method of preserving such surfaces is the application of a bituminous material of such quality that the bond will be tough enough to resist the stresses that are applied. If this dust and chip bond can be preserved, the large stones cannot become loose or pushed out, rutting will not occur, and the wear on the surface

Rating of State Sanitary Control of Public Water-Supplies

BASED on a rating scale having 1000 as perfect, the state control of water-supplies in the United States ranges from 970 points for Ohio and Michigan to 10 for Missouri. The rating, which was made by the United States Public Health Service, in 1919, shows seven states as "excellent," eight as "good," 15 as "fair," eight as "poor" and nine as "very poor." Details are given by the accompanying map. About two-thirds of the departments have one or more engineers, Pennsylvania leading with a chief engineer and 15 assistant engineers.



Figures indicate Rating based on a possible 1000

Excellent		Good		Fair				Poor		Very Poor			
OHIO	970	FLA.	865	VT.	785	MICH.	710	ALA.	555	WASH.	340	WY.	110
MASS.	970	N.C.	855	CALIF.	775	OKLA.	710	ORE.	540	COLO.	260	MO.	10
KAN.	930	PENN.	850	TEX.	770	GA.	695	IND.	535	S.D.	250		
N.J.	910	LA.	850	CONN.	760	IOWA	660	NEB.	480	ARIZ.	225		
R.I.	910	KY.	835	VA.	760	UTAH	640	N.D.	470	N.M.	200		
MINN.	910	N.H.	835	MAINE	730	WIS.	630	ARK.	470	TENN.	160		
MONT	900	MD.	830	W.VA.	730	S.C.	615	NEV.	430	MISS.	130		
		ILL.	830	N.Y.	710			IDAHO	420				

will be dependent on the hardness and toughness of the larger stones of which it is composed.

The first two classes of treatment, involving the formation of a heavy mat on the original macadam, tend toward giving an uneven surface by cracking off in spots, where hard binders are used, and pushing and bunching when successive treatments of soft binders are used. Furthermore, the cost of these heavy carpets often warrants the construction of a more expensive type of surface. From observations covering a period of eight years, the writer has found the third class of treatment overcomes the objections referred to above.

Aside from the materials used in treatment, the character of the surface to be treated must be considered, if the best results are to be obtained. This is especially so with respect to the size of stones composing the wearing course. Upon this size depends, primarily, the success or failure of the treatment, and consequently the cost of maintenance. The Borough of Columbia has found that on streets where wearing courses are composed of stones less than 1½ in. in size, economy warrants resurfacing them with ballast ranging from 1½ to 3 in., in preference to attempting to maintain the original surface with bituminous materials. The extra expense of maintaining a surface composed of small stones is occasioned by the fact that after the first application a continuous breaking out in spots to a depth of about 1 in. results. These spots soon wear down to the foundation, or, if they are packed with bituminous material and stone, the cost becomes greater annually than the interest on the investment required to place a new surface composed of the larger sizes.

Consideration of the accompanying surface diagram shows the reason for this breaking out. The untreated macadam is a one-layer surface, and breaking begins

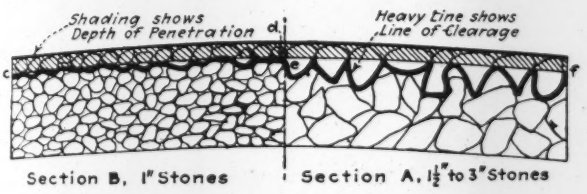


DIAGRAM SHOWS PLANE OF CLEAVAGE ON LARGE AND SMALL STONE SURFACINGS

at the top, where the stress is greatest. An application of bituminous binder transforms this single layer into a surface composed of two distinct layers, the top one of which is composed of bitumen, screenings and stone, and the bottom one of screenings and stone. Providing that a proper penetrating and binding material has been used, the weakest part of the original surface is along the plane between the two layers (shown on the diagram by the heavy black, irregular line), and it is along this plane that the top breaks away from the bottom, causing pot-holes, as noted above. The position of this plane of breaking is entirely dependent upon the size of the stones used. In order to overcome this, it is necessary that this plane of division be so far beneath the surface that the distributed unit stress at that point will be less than the adhesion.

Section B of the diagram shows that, in a surface composed of 1-in. stone and ¾-in. penetration the position of this breaking plane is about 1 in. from the top, designated by the line b-d. With 1½- to 3-in. stone and ¾-in. penetration this plane e-f is shown by Section A of the diagram to vary from 1½ to 3 in. from the top. It follows that for the same thrust at the surface the unit stresses resulting along the division plane in the small stone surface will be about four times as great as that along the plane in the large stone surface. More than that, the mechanical bond furnished by the larger stones offers greater resistance to separation than that of the smaller, making the ratio far more than 4 to 1.

It has been observed that traction-engine lugs will break out sections of treated small stone surfaces, while no impression is made on those composed of large stones. While small stone surfaces one year after treatment are often full of holes, adjoining surfaces composed of larger stone, from the same quarry, treated at the same time with similar material, are practically free from such breaks.

Experience in Columbia

Since 1912 the Borough of Columbia has used various light and heavy materials, in an effort to preserve its macadam surfaces, and has finally adopted Tarvia-B covered with a light layer of sand, as the treatment which accomplishes most economically and effectively the required result. Before treatment the streets are resurfaced with large stone macadam. After proper seasoning the bituminous material is applied simply as a preservative or paint coat, with no attempt to build up a mat. The excess material is taken up by a thin layer of river sand.

As examples of the success of this treatment in Columbia, two streets carrying heavy traffic may be cited. The application of Tarvia-B was first made on N. 3rd St. in 1912, following the construction of a 6-in. macadam surface. The binder was applied by hand and spread by brooms at the rate of ¼ gal. per square yard, and covered with river sand at the rate of 1 cu.yd. to every 330 sq.yd. of surface. In 1913 a second application was made at the rate of 0.13 gal. per square yard, at a cost of 2c. Since then it has received annual treatments of tar and sand at the rate of 0.11 to 0.19 gal. at a total average cost of 2.3c. per square yard. This street carries the maximum traffic of a manufacturing town of 14,000 population, and, since 1914, has taken the foreign traffic of the Lincoln Highway. The street is very satisfactory as to appearance, cleanliness and suitableness for traffic.

Locust St., between 4th and 5th Sts., was resurfaced with limestone and coated with Tarvia-B and sand in 1913. The first application was made by hand at the rate of 0.27 gal. per square yard, and broomed. The cost was 4.6c. It was covered with river sand at the rate of 1 yd. to every 290 square yards. Since then it has received annual treatments at the rate of 0.15 gal., at a cost of 2.3c. per square yard. It carries the same traffic as N. 3rd Street.

From observation of coatings on over 600,000 sq.yd. of surface since 1912, on which the bituminous material was applied by means of gravity and pressure, horse-drawn and motor distributors, and by hand with brooms, the writer has found that the most satisfactory and protective coating can be had by sweeping the surface clean, applying the tar from a pouring pot, spreading it by push brooms and covering it with a light layer of sand, and immediately opening the street to traffic. By brooming the tar, a minimum quantity can be used, thus allowing none to stand in puddles or to

run down at the sides. This saving in cost of tar more than offsets the additional cost of spreading by hand over that of spreading by machine.

Sand forms a harder and tougher resisting surface than chips or slag and presents a cleaner, smoother and more finished appearance to the eye. Notwithstanding this smooth appearance, there have been less complaints of horses slipping on sanded surfaces than on those covered with slag. Upon close examination of this matter, it is found that the sanded surfaces are actually rougher after several months' wear. While other coverings often wear so smooth as to offer almost no foothold for horses, the grains of sand, instead of wearing smooth, break out, leaving a sandpaper finish which effectually prevents slipping and skidding.

At present there are about 130,000 sq.yd. of street surface in the borough under the preferred treatment and giving satisfactory results. The average first coatings were made at the rate of 0.25 gal. per square yard and subsequent coats at from 0.1 to 0.2 gal., with a cubic yard of sand covering 300 sq.yd. The total average cost of first treatment from 1912 to 1918 was 4c. per square yard and subsequent treatments cost 2c. per square yard. In some residential sections with light traffic, treatments were required only every other year.

The average cost for the first 100,000 sq.yd. treated in 1919 was 3c. per square yard. The average rate of application was 0.15 gal., with a minimum of slightly less than 0.1 gal. per square yard. On an average, a cubic yard of sand covered 290 sq.yd. of surface. The total average cost of hauling and labor was 0.6c. per square yard. The maximum yardage was covered June 20, when a foreman, two carts and 11 men coated 9775 sq.yd. in an eight-hour working day. The average yardage of the work done by this force was 6000 in nine hours.

The New City Zoning Ordinance of Alameda, California

Eight Classes of Use Districts and Four Building-Height Districts Established—Area of Lot That May Be Built On

By Charles E. Hewes
City Manager, Alameda, Calif.

WHAT is probably the most completely worked out and comprehensive zoning ordinance so far adopted in the United States was passed by the Alameda City Council on the recommendation of the city manager and advisory city-planning commission in February, 1919, and became effective Mar. 18 following. Alameda is a city of approximately 35,000 population, with about four miles of industrial waterfront along the north side of the city, and recreation beaches on the south side, the main portion of the city being a large island, with a second undeveloped area of several square miles of farm land, on Bay Farm Island, to the southeast.

After a year's careful study of the tendencies of growth in all parts of the city and the preparation of use-of-property and heights-of buildings maps, the city's consultant in city planning, Charles H. Cheney, held neighborhood meetings and conferences in each of the principal districts and centers of the city, some 40 conferences in all being held. At these an agreement was reached concerning what protections would be for the best interest of property owners in each neighborhood. These neighborhood recommendations were then combined in a general zoning plan, and the whole was put up for public hearing as the preliminary form for the zoning regulations. So well had the preliminary work of education been done, however, that there were practically no objections to the ordinance, either at this time or at the later hearings after it was introduced before the city council.

This ordinance is expected to stabilize property values, prevent the deterioration of residence districts, help business by requiring its concentration at established centers, and by making a definite place for industries to locate and invest where they will be safe from protest and interference.

It combines the best features, we believe, of the Los Angeles, St. Louis and New York ordinances, and is similar to the zone ordinance adopted in Palo Alto (population 6000) in August, 1918.

The ordinance applies to new building permits only, the existing buildings and uses of property not being affected even though they fall outside the respective zones proper for them.

Eight Classes of Use Districts Found Necessary

Eight classes of use districts were found to be the minimum that would cover our requirements. The use districts are as follows:

Class I. Residence: Single-family dwellings only, covering about two-thirds of the residence area of the city.

Class II. Residence: Any kind of dwellings, flats, dormitories, apartments, hotels without stores, covering about one-third of the city, in which flats and apartments were already established.

Class III. Business and Public Use: Ordinary, better-class retail business, trades and professions, including residences of Classes I and II. Two principal business centers of the city, on Webster St. and on Park St., each some six blocks long, were put into this class, with smaller business districts of Class V adjoining them.

Class IV. Business and Public Use: Schools, public and semi-public buildings, churches, playgrounds, greenhouses and nurseries and parks, including single-family dwellings. All such institutions throughout the city have been placed in small districts of this class, comprising only the size of the lot which they occupy.

Class V. Business and Public Use: All types of business use of Class III, plus public garages, dyeing and cleaning establishments, wholesale business, warehouses, oil-supply stations and any kind of residence, or public use of Classes I, II, III or IV. They comprise small areas adjoining the Class III centers, and also many little local business centers at cross-roads in residence sections.

Class VI. Business and Public Use: Hospitals, sanitariums, charitable institutions, and any kind of residence of Classes I and II. As yet no districcts of this class have been assigned. Any new institutions of this type will have to have a public hearing and secure approval of the neighborhood and amendment of the zoning plan, before locating.

Class VII. Industrial Districts: All ordinary, non-obnoxious factories, warehouses and industries, including any business use, but excluding new residences of any kind. A district one-half mile wide and about three miles long, along the north water front, was established,

where the present industries of the city are located. Another industrial district was also provided on Bay Farm Island, for future development. The first district is identical with the previous industrial zone established by ordinance a year ago, which, also, prohibited new dwellings from going in and blocking the growth of industry.

Class VIII. Industrial Districts: Obnoxious and odor-producing factories, including any business use, but excluding new residences of any kind. One district of this kind only has been established now, on the leeward side of the city, where the prevailing winds will blow smoke and odors away from the city, across the bay marshes to the eastward.

Building Height Limits Established

The ordinance also provides for protecting the various parts of the city from the dangers of overcrowding, and depreciation of property values by the building of scattered over-high structures. The following height districts were arranged to protect the existing tendencies of growth:

Two-and-a-half Story: All new buildings to be limited to a maximum of two stories and finished attic, not to exceed a total height of 35 ft. to the finished line of the attic floor above the curb. As over 99% of all the buildings in the city were found to be of this type, or less in height, the city felt justified in maintaining this tendency. This height limit was placed upon the residence districts of Class I.

Three-story: Not to exceed 40 ft. to the finished ceiling line of the third floor; established to cover the Webster St. business district and residence districts of Class II, for hotels, flats and dwellings.

Four-story: Not to exceed 50 ft. to the finished ceiling line of the fourth floor. One district of this kind only was established for the present, to cover the principal business center of Classes III and V on Park Street.

Eight-story: Not to exceed 90 ft. to the finished ceiling of the eighth story, to cover the industrial districts of Classes VII and VIII. This is perhaps a higher limit than necessary. The city's consultant advised four stories, which had been the limit in our previous industrial-zone ordinance of 1918. Some of the planning commission could not understand the need for any limits, and the compromise height of eight stories resulted.

Towers, tanks, chimneys, spires, etc., covering an area of not more than 15% of the lot, are allowed to be built up to any height.

Area Requirements to Insure Light and Air

In industrial districts of Classes VII and VIII, where windows are needed for light and air, a rear yard of not less than 5 ft. must be provided.

In business and public use districts of Classes III, IV, V and VI all yards and courts, where required for light and air, must not be less in dimensions than required for tenement houses in the California state tenement-house act.

In residence-use districts of Classes I and II, yards and courts, whatever use the building is put to, must be the same as for a dwelling in the California state dwelling-house act.

A special class of "home area districts" includes all Class I single-family dwelling districts and provides that no lot may hereafter be covered more than 50%. It was found that practically all of the dwellings in these districts now cover only from 20 to 25% of the lot, and that therefore this restriction would not be stringent.

I am glad to say that there are no "unrestricted districts" or unfinished portions of the zoning work in this ordinance, such as have been left in some of the larger cities, although it is less difficult in a small city to leave them in. Alameda, therefore, has complete control of the situation. However, new locations for industries, particularly adjoining railroad lines, and other changes of districts, can be brought about, by amending the ordinance and holding public hearings, in a very short time. No such changes, however, can hereafter be made without the neighborhood being consulted, and none of the city is left in uncertainty. We expect the ordinance to be amended from time to time to keep pace with the needs of the city as it grows.

With the zoning of the city settled upon, Alameda has a definite and exact basis on which to lay out a major-traffic street plan. The minor residential streets are determined by the zones established, and can be paved with less costly and narrower pavements, with more parking accordingly. The fire limits of the city can be rearranged to cover only business districts, and so no hardship is worked on other areas. A sound basis for mortgage loans has been established, thus stabilizing land values, and making a surer and easier foundation for city assessments and taxation.

Zoning is a fundamental move in city progress from which we anticipate a great deal of good in Alameda.

Holding Power of Track Spikes

Laboratory Tests Indicate Advantages of a Spike With Grooved Shank as Compared With Ordinary Drive Spike

COMPARATIVE tests on the holding power of two types of drive spikes indicate an advantage for a new design. The tests were made for the American Spike Co., New York, using a specially grooved shank over the ordinary cut spike. The former is the Sessler grip spike, shown in the accompanying drawing, while the latter is the standard chisel-point spike of the Pennsylvania Railroad, Western Lines, having a ⅝-in. shank 6 in. long under the head. Screw spikes of the type used on the Delaware, Lackawanna & Western R. R. were included for comparison with the drive spikes. These tests were made at Columbia University, New York, by Albin H. Beyer and William J. Krefeld, in the laboratory of the department of civil engineering.

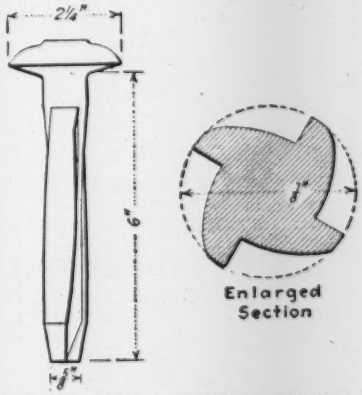


FIG. 1. NEW TRACK SPIKE HAS SPIRALLY GROOVED SHANK

Tests were made with both types of drive spikes driven into solid wood and into bored holes, the diameter of the hole being ½ in. for the cut spike and $\frac{7}{16}$ in. for the grip spike. Taking an average of all the kinds of wood used and taking the hold of a cut spike

driven without a hole as 100%, the other spikes show as follows: Cut spikes in hole, 93.1%; grip spike, 129.3% without hole and 122.7% with hole; screw spike with hole, 172.9%. While these results indicate a slightly greater initial resistance for the spikes driven into solid wood, the report states that this increase is of doubtful value, as the efficiency and ultimate life of a spike in a tie depends more upon the range of elastic behavior of the wood fibers, provided the friction between these fibers and the spike is sufficient.

A cut spike driven into solid wood crushes and

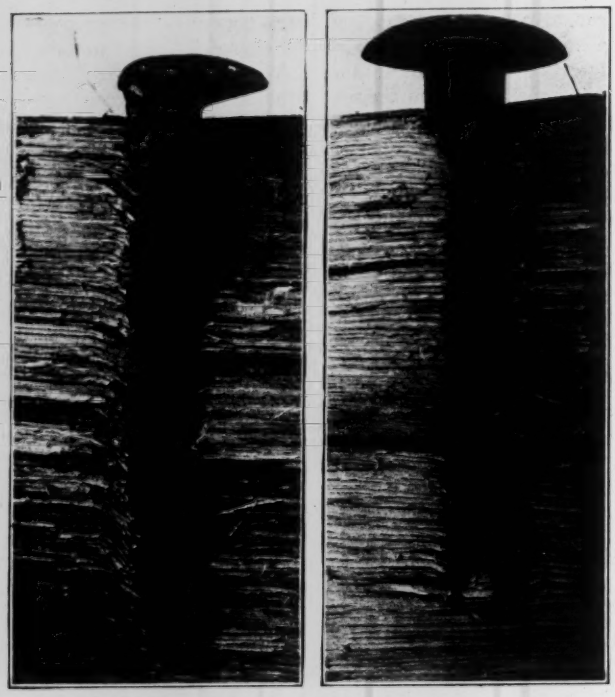


FIG. 2. DRIVE SECTIONS PRODUCED BY CUT AND GROOVED SHANK SPIKES USED IN TESTS

bunches the fibres over a wide area, due largely to the splitting and wedging action being confined to one plane. With the grip spike this splitting action appears to be less, due partly to the shape of the point,

AVERAGE HOLDING POWER OF SPIKES

	Cut Spike No Hole lb.	Cut Spike ½-in. Hole lb.	Grip Spike No Hole lb.	Grip Spike ⅞-in.-Hole lb.	Screw Spike in Hole lb.
Chestnut	5150	4908	7,180	6,100	9,100
Creosoted yellow pine	4850	4700	6,890	6,500	8,500
White oak	9020	8700	10,300	11,800	15,560
Douglas fir	4280	3539	5,200	4,600	7,170

but more particularly to the fact that the spike rotates in driving, its average turn being 63° in solid wood and 68° when driven in a bored hole. The report states

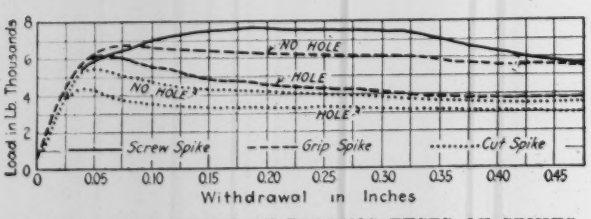


FIG. 3. COMPARISON OF PULLING TESTS OF SPIKES

that in this way the splitting and wedging action is not confined to one plane, and that the cumulative effect upon the wood fibers appears to be reduced. With both spikes the crushing and bunching of the wood fibers can be reduced materially by boring the hole. It may be noted that the effect on the wood de-

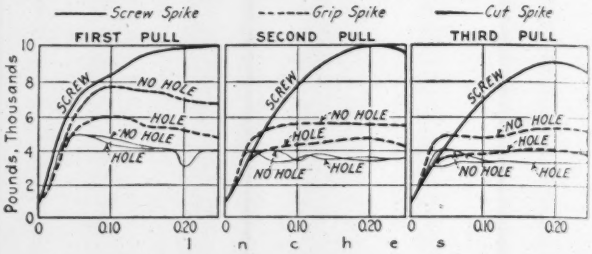


FIG. 4. COMPARISON OF RESULTS WITH REDRIVEN SPIKES

pends largely upon the efficiency of the operator, and that the report explains that these test spikes were driven by a man inexperienced in track work.

Sections of the drives of the ordinary cut spike and the grooved shank spike are shown in Fig. 2. The average results of the pulling tests are shown in the accompanying table and in Fig. 3, the latter representing tests in an untreated chestnut tie. Another set of tests was made with the spike pulled ¼ in. and then twice redriven and pulled, thus simulating the condition for track spikes which work loose and are driven home. Fig. 4 shows the results in chestnut ties. For the relative average elastic limits of withdrawal, taking the cut spike at 100% the report gives that of the grip spike as 129% and that of the screw spike as 90% for the elastic limit in bearing and 178% for the final yield point.

Unemployment Reduced by Societies' Bureau

The Engineering Societies' Employment Bureau's latest report to Engineering Council summarizes the bureau's activities for the ten months, Dec. 1, 1918-Sept. 30, 1919, in the following figures:

Men interviewed	17,083
Men registered	4,858
Men reported placed	1,000
Positions registered	1,988
Letters of application forwarded	15,691
Pieces of mail sent out	19,974
Expenditures	$10,601.19

It is explained in the report that the figure for the number of men reported placed is only approximate and, indeed, much lower than it should be, due to the great difficulty of getting reports from men after they have obtained positions. The majority of the positions registered, the report says, pay from $125 to $175 per month. Col. Arthur Woods, late head of the War Department Employment Service, commended the work of the bureau and said that the cost of operation as shown in the bureau's report was very low, considering the highly technical and professional character of the men served. Although the joint bureau arrangement in New York City has been discontinued, the Engineering Societies' Bureau continues to coöperate with the War Department, the Red Cross, the Young Men's Christian Association, the War Camp Community Service, the Knights of Columbus, and all college organizations, which refer to the bureau all engineering applicants and positions listed. The number of engineers visiting the bureau's office in New York ranges from 60 to 70 per day.

Industrial Conference Makes Preliminary Statement

Body Appointed by President Invites Criticism of Plan for Federal Tribunal To Adjust Industrial Disputes

A "PRELIMINARY statement," submitted with the object of promoting discussion and constructive criticism, was made public Dec. 29 by the President's Industrial Conference. That portion of the report dealing with the mechanism for carrying out its tentative plan for the adjustment of industrial differences by a National Tribunal and Regional Boards is reproduced, in full, below:

Introduction

The Industrial Conference, convened by the President in Washington on Dec. 1, issues this statement in the desire that certain tentative proposals be given considerate study by interested individuals and organizations throughout the country. It will reassemble on Jan. 12 and will then carefully consider any constructive criticisms that may be submitted to it.

The Conference does not deem it useful at this time to enter upon a discussion of the causes of industrial unrest. It believes rather that its most important immediate contribution is the suggestion of practical measures which will serve to avert or postpone industrial conflicts.

In confining itself to the proposal of machinery for the adjustment of disputes, the Conference is far from wishing to exaggerate the importance of the mechanical as contrasted with the human elements in the situation. Our modern industrial organization, if it is not to become a failure, must yield to the individual a larger satisfaction with life. It makes possible a greater production of material things. But we have grown so accustomed to its complexity that we are in danger of forgetting that men are today more dependent on each other than ever before. The spirit of human fellowship and responsibility was easier to maintain when two or three worked side by side and saw the completed product pass from their hands. Yet their co-operation was actually less necessary because each by himself was more nearly capable, if circumstances demanded, to meet the needs of life. Today we have a complex interweaving of vital interests. But we have as yet failed to adjust our human relations to the facts of our economic interdependence. The process toward adjustment, though slow, nevertheless goes on. The right relationship between employer and employee in large industries can only be promoted by the deliberate organization of that relationship. Not only must the theory that labor is a commodity be abandoned, but the concept of leadership must be substituted for that of mastership. New machinery of democratic representation may be erected to suit the conditions of present industry and restore a measure of personal contact and a sense of responsibility between employer and employee. The more recent development of such machinery with the co-operation of organized labor is a hopeful sign. But back of any machinery must be the power which moves it. Human fellowship in industry may be either an empty phrase or a living fact. There is no magic formula. It can be a fact only if there is continuous and sincere effort for mutual understanding and an unfailing recognition that there is a community of interest between employer and employee.

Pending the growth of better relationships between employers and employees, the practical approach to the problem is to devise a method of preventing or retarding conflicts by providing machinery for the adjustment of differences. The Conference believes that it is possible to set up a more effective series of tribunals for the adjustment of disputes than at present exists. To be successful, such tribunals must be so organized as to operate promptly as well as impartially. There must be full participation by employers and employees. There must be representation of the public to safeguard the public interest. The machinery should not be used to promote unfairly the interests of organizations, either of labor or of capital. The plain fact is that the public has long been uneasy about the power of great employers; it is becoming uneasy about the power of great labor organizations. The community must be assured against domination by either. On the other hand, there must be equal assurance that such machinery will not be used to discriminate against organizations of employees or of employers. Both should be protected. The right of association on either side should not be affected or denied as a result of the erection of such tribunals.

The plan which follows does not propose to do away with the ultimate right to strike, to discharge, or to maintain the closed or the open shop. It is designed to bring about a frank meeting of the interested parties and cool and calm consideration of the questions involved, in association with other persons familiar with the industry.

The plan is national in scope and operation, yet it is decentralized. It is different from anything in operation elsewhere. It is based upon American experience and is designed to meet American conditions. To facilitate discussion, the plan submitted, while entirely tentative, is expressed in positive form and definite as to most details.

Plan for Boards of Inquiry and Adjustment

There shall be established a National Industrial Tribunal, and Regional Boards of Inquiry and Adjustment.

The National Industrial Tribunal shall have its headquarters in Washington, and shall be composed of nine members chosen by the President and confirmed by the Senate. Three shall represent the employers of the country and shall be appointed upon nomination of the Secretary of Commerce. Three shall represent employees and shall be appointed upon nomination of the Secretary of Labor. Three shall be representatives of the public interest. Not more than five of the members shall be of the same political party.

The tribunal shall be, in general, a board of appeal. Its determinations on disputes coming to it upon an appeal shall be by unanimous vote. In case it is unable to reach a determination, it shall make and publish majority and minority reports which shall be matters of public record.

The United States shall be divided into a specified number of industrial regions. The Conference suggests twelve regions with boundaries similar to those established under the Federal Reserve system, with such modifications as the industrial situation may make desirable.

In each region the President shall appoint a regional chairman. He shall be a representative of the public interest, shall be appointed for a term of three years and be eligible for reappointment.

Whenever in any industrial region, because of the multiplicity of disputes, prompt action by the Regional Board is impossible, or where the situation makes it desirable, the National Industrial Tribunal may in its discretion choose one or more vice-chairmen and provide for the establishment under their chairmanship of additional regional boards.

Panels of employers and employees for each region shall be prepared by the Secretary of Commerce and the Secretary of Labor, respectively, after conference with the employers and employees, respectively, of the regions. The panels shall be approved by the President.

At least twenty days before their submission to the President provisional lists for the panels in each region shall be published in such region.

The panels of employers shall be classified by industries, the panels of employees shall be classified by industries and subclassified by crafts. The names of employers and employees selected shall be at first entered on their respective panels in an order determined by lot.

The selection from the panels for service upon the Regional Boards shall be made in rotation by the regional chairman; after service the name of the one so chosen shall be transferred to the foot of his panel.

Whenever a dispute arises in a plant or group of plants which is not settled by agreement of the parties or by existing machinery, the chairman may on his motion, unless disapproved by the National Industrial Tribunal, and shall at the request of the Secretary of Commerce or the Secretary of Labor or the National Industrial Tribunal, request each side concerned in such dispute to submit it for adjustment to a Regional Board of Adjustment. To this end each side shall, if willing to make such submission, select within not less than two nor more than seven days, at the discretion of the chairman, a representative. Such selection shall be made in accordance with the rules and regulations to be laid down by the National Industrial Tribunal for the purpose of insuring free and prompt choice of the representatives.

When both sides shall have selected their representatives the chairman shall take from the top of the panels for the industry concerned, or in the case of employees for the craft or crafts concerned, names of employers and employees, respectively. The representatives selected by the two sides shall be entitled to a specified number of peremptory challenges of the names so taken from their respective panels. When two unchallenged names of employers and employees shall have been selected in this manner, they, with the chairman and the representatives selected by the two sides, shall constitute a Regional Board of Adjustment.

The appointment of representatives of both sides shall constitute an agreement to submit the issue for adjustment and further shall constitute an agreement by both sides that they will continue, or re-establish and continue, the status that existed at the time the dispute arose.

The Board of Adjustment so constituted shall proceed at once to hear the two sides for the purpose of reaching a determination. Such determination must be by unanimous vote. In case the board is unable to reach a determination the question shall, unless referred to an umpire, as later provided, pass upon appeal to the National Industrial Tribunal.

Regional Boards of Inquiry

If either side to the dispute fails, within the period fixed by the chairman, to select its representative, the chairman shall proceed to organize a Regional Board of Inquiry. Such Regional Board of Inquiry shall consist of the regional chairman, two employers selected in the manner specified from the employers' panel, and two employees selected in like manner from the employees' panel and of the representative of either side that may have selected a representative and agreed to submit the dispute to the board. If neither side shall select a representative within the time fixed by the chairman, the Board of Inquiry shall consist of the chairman and the four panel members only.

Upon the selection of a representative, within the specified time, the side concerned shall be entitled to the specified number of peremptory challenges as provided above. The representative shall have the right to sit on the Board of Inquiry and to take full part as a member of such board in the proceedings thereof.

The Board of Inquiry as so constituted shall proceed to investigate the dispute and make and publish a report, or majority and minority reports, of the conclusions reached, within five days after the close of its hearings and within not more than thirty days from the date of issue of the original request by the chairman to the two sides to the dispute, unless extended on unanimous request of the board or the National Industrial Tribunal. It shall transmit copies of this report or reports to the Secretaries of Commerce and of Labor, respectively, and to the National Industrial Tribunal, where they shall be matters of public record.

At any time during the progress of the inquiry at which both sides shall have selected representatives and agreed to submit the dispute for adjustment, the Board of Inquiry shall become a Board of Adjustment by the admission to membership on the board of such representatives. The side or sides which appoint representatives after the date fixed in the original request of the chairman shall, because of its delay, suffer a reduction in the number of peremptory challenges to which it otherwise would have been entitled.

The Board of Adjustment so constituted shall proceed to the determination of the dispute as though it had been organized within the period originally fixed by the chairman.

When a Regional Board of Adjustment is unable to reach a unanimous determination it may by unanimous vote select an umpire and refer the dispute to him with the provision that his determination shall be final and shall have the same force and effect as a unanimous determination of such Regional Board.

Whenever the questions involved in a dispute extend beyond the boundaries of a single region, the regions to which the dispute extends shall, for the purpose of such dispute, be combined by order of the National Industrial Tribunal, which shall designate the chairman of one of the regions concerned to act as chairman in connection with the dispute in question.

Two employer members and two employee members shall be chosen from the combined panels of the regions involved in the dispute under rules and regulations to be established by the National Industrial Tribunal. The members representing the two sides to the dispute shall be chosen as in the case of a dispute in a single region.

A Regional Board of Inquiry or of Adjustment constituted for a dispute extending beyond the boundaries of a single region shall have the same rights and powers conferred upon a Regional Board for a single region.

Effect of Decision—Whenever an agreement is reached by the parties to a dispute or a determination is announced by a Regional Board of Adjustment, or by an Umpire, or by the National Industrial Tribunal, the agreement or determination shall have the full force and effect of a trade agreement which the parties to the dispute are bound to carry out.

General Provisions

In connection with their task of inquiry and adjustment, the Regional Boards and the National Tribunal shall have the right to subpœna witnesses, to examine them under oath, to require the production of books and papers pertinent to the inquiry, and their assistance in all proper ways to enable the boards to ascertain the facts in reference to the causes of the dispute and the basis of a fair adjustment. Provision shall be made by law for the protection of witnesses and to prevent the misuse of any information so obtained.

All members of the tribunal and boards heretofore described, including the chairman and vice-chairman, shall be entitled to vote.

The President shall have the power of removal of the members of the tribunal and boards.

In the presentation of evidence to the tribunal and the boards each side shall have the right to present its position through representatives of its own choosing.

The Secretary of Commerce and the Secretary of Labor in making nominations for the National Industrial Tribunal and in preparing and revising the regional panels of employers and employees shall from time to time develop suitable systems to insure their selections being truly representative.

The National Industrial Tribunal, the Regional Boards of Adjustment, and the Umpires shall in each of their determinations specify the minimum period during which such determinations shall be effective and binding. In case of emergency a Regional Adjustment Board or the National Industrial Tribunal may, after hearing both sides, alter its determination by abridging or extending the period specified.

The terms of office of members of the National Industrial Tribunal shall be six years; at the outset three members, including one from each group, shall be appointed for a term of two years, three members for a term of four years, and three members for a term of six years; thereafter three members, one from each group, shall retire at the end of each period of two years. Members shall be eligible for reappointment.

The regional panels provided for hereinbefore shall be revised annually by the Secretaries of Commerce and

Labor, respectively, in conference with the employers and employees, respectively, of each region.

Relation of Boards to Existing Machinery for Conciliation and Adjustment—The establishment of the National Industrial Tribunal and the Regional Boards described shall not affect existing machinery of conciliation, adjustment, and arbitration established under the Federal Government, under the governments of the several states and territories or subdivisions thereof, or under mutual agreements of employers and employees.

Any industrial agreement made between employers and employees may, by consent of the parties, be filed with the National Industrial Tribunal. Such filing shall constitute agreement by the parties that in the event of a dispute they will maintain the status existing at the time the dispute originated until a final determination, and that any dispute not adjusted by means of the machinery provided through the agreement shall pass on appeal to the National Industrial Tribunal for determination, as in the case of a dispute submitted on appeal from a Regional Board.

The report concludes with the declaration of policy that the interruption of essential public utilities is intolerable and that Government employees concerned with the administration of justice or the public safety should not be permitted to join organizations which authorize the use of the strike.

The report is signed by the following:

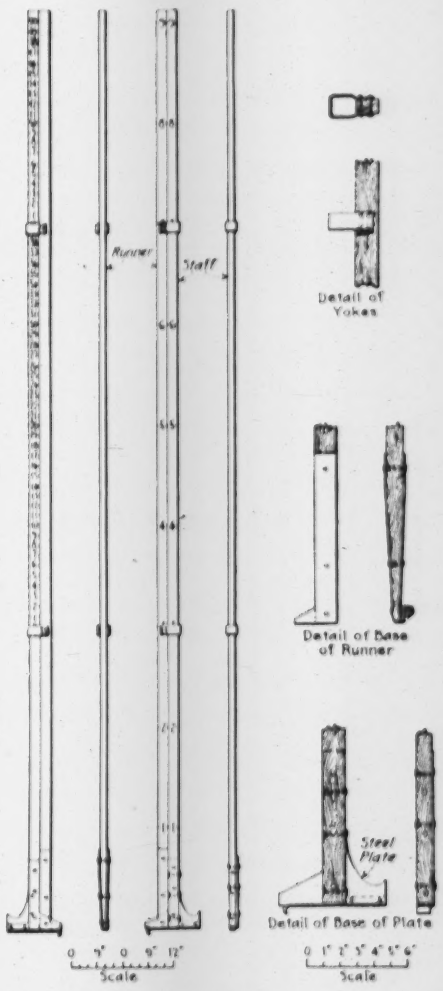
W. B. WILSON, *Chairman*	HENRY M. ROBINSON
	JULIUS ROSENWALD
HERBERT HOOVER, *Vice Chairman*	OSCAR S. STRAUS
	HENRY C. STUART
MARTIN H. GLYNN	F. W. TAUSSIG
THOMAS W. GREGORY	WILLIAM O. THOMPSON
RICHARD HOOKER	HENRY J. WATERS
STANLEY KING	GEORGE W. WICKERSHAM
SAMUEL W. McCALL	OWEN D. YOUNG

Unique Rod Made for Canal Soundings and Stream Measurements

A COMBINATION rod, the chief function of which is to take soundings in irrigation canals, but which serves various other uses—including cutting grass and moss, or removing trash from headings, bridge piers, or trash racks—is a development of years of use of many devices by W. G. Steward, formerly assistant engineer, United States Reclamation Service, Boise, Idaho, and now associate professor of agricultural engineering at the University of Idaho, Moscow. Mr. Steward recommends that the pole, if made of properly selected straight-grained wood, can be used for vaulting narrow canals, for laying off sections at a station, and it may assist materially in taking stream measurements. Where close work is not required, the pole has been used as an ordinary level rod.

This rod is 9 ft. in length and fitted with a runner much the same as an ordinary level rod. The bottom of the staff is fitted with a foot plate, one end of which is curved under to hold the rod to the bottom of the section, where the water is deep and swift and the bottom is of hard, smooth material like concrete or rock. The base of the staff is made large, so as to get more nearly the mean elevation of the surface of the stream bed. Attached to the foot plate and the bottom of the staff is a curved, sharpened, steel plate which serves as a grass hook. The rod is graduated in feet on one side, the obverse being graduated in tenths, the zero being set at the top of the two yokes attached to the runner and set at elevations on the rod of 3 and 7 ft., respectively.

When soundings are taken, the bottom of the staff is allowed to rest on the bottom of the section of the canal, the runner being elevated until the base skims the water. Soundings 2 ft. or less may be read from



DETAILS OF COMBINATION SOUNDING ROD

the top of either the upper or lower yoke. When the water is over 4 ft. deep any reading on the upper 2 ft. is added to 4 ft. Where the water is over 6 ft. deep, 3 ft. is added to the figures opposite the base of the runner.

Buildings Prohibited Where No Sewers

Under an ordinance passed by the City Council of Cleveland, Ohio, in November, 1919, the issuance of building permits on streets not provided with sewers is prohibited. There is a proviso, however, that the Commissioner of Buildings may issue such permits on receipt of a written statement from the Commissioner of Engineering that there is a prospect of sewerage facilities being provided within a reasonable time. A further proviso is to the effect that in exceptional cases a permit may be issued on the strength of a written communication from the Commissioner of Health that such action "will not jeopardize the public health and welfare because of the use to which the building may be put."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Believes A. A. E. Will Not Support National Societies' Plan for Comprehensive Body

Sir—The report of the Joint Conference Committee of the four national societies, outlining a plan for a comprehensive national body, given on p. 835, and your editorial upon the same subject found on p. 846 of the Nov. 13-Nov. 20 issue, appear to me to overlook some very fundamental considerations.

For many years progressive members of the national technical societies preached the necessity for attending to the economic side of engineering. They tried many times to get something started similar to the plan now advocated. The younger engineers looked on with hope and expectation. The aristocracy of long years of experience set up by these societies through their high requirements for membership was accepted as a good thing. The thought was that these men of great technical ability would naturally be altruistic and of broad enough vision to see the human problems of the whole engineering field and provide the machinery for coping with them.

But those societies failed to see their opportunity and that duty. I believe I voice the attitude of thousands of the younger engineers when I say that we are skeptical of the old technical societies ever being capable of representing the whole profession of engineering, and particularly the interests of the younger engineers and those in less responsible positions. The plan of the Joint Conference Committee should have been laid out ten years ago and put into effect not later than five years ago. *Their opportunity is gone.*

Some of those who saw the need gave up the idea of ever getting the technical societies to take up that work. They gathered, and formed the American Association of Engineers as late as 1915, and this association is all that the Joint Conference Committee would have the technical societies become.

The early days of the new organization were overcast with doubt and misunderstanding. The ever-increasing stress of the economic conditions blinded many to the right course, and there were concerted attempts to make the association "a collective bargaining union." However strong those attempts may have been, A. A. E. never succumbed to them. Under the guidance of a few big engineers the structure and principles of this association became well founded upon professional ethics.

To-day A. A. E. is larger than any of the technical societies, and its rate of growth promises that within two years it will be larger than the combined national technical societies. It is thoroughly democratic, and its requirements for membership have been made low enough to make every professional technical man eligible and yet high enough to keep the nonprofessional man out.

Its structure is well designed to handle economic problems. The country is divided geographically into clubs, chapters and districts having complete jurisdiction over local problems not affecting more than their own localities, but which must coördinate their work through the national headquarters in all matters common to more than one locality. Then, in order to obtain direct information and concerted action in any branch of engineering, sections and departments are being formed. For instance, the New York Central Railroad Section is a part of the Railroad Department. Sections and departments do not have the same functions as clubs, chapters and districts, but are standing committees of a special character.

This association has done more for engineers in its four years of existence than all the technical societies together. A large percentage of its members are also members of national technical societies.

Now, does the Joint Conference Committee of the founder societies expect the members of A. A. E. to be so ungrateful for what the association has done as to throw it over and join a new combination? Would that be ethical? Certainly not. Does it not seem that the ethical procedure for the technical societies now is to acknowledge their shortcomings and give the new association their hearty support? The least they should do is not to compete with it.

The technical societies have done well for what they were designed, but how can anyone expect this proposed new combination to be a success built upon societies whose character and constitutions are not fitted for dealing with economic problems? The Bible teaches and history has proved, "No man putteth new wine into old bottles; else the new wine doth burst the bottles, and the wine is spilled, and the bottles will be marred; but new wine must be put into new bottles." (Mark II, 22).

J. HOLLOWAY MORGAN,
Certified Member, American Association of Engineers.
Washington, D. C.

Mr. Baker's Railroad Plan

Sir—Mr. Baker's article on the "Railway Problem" has exceptional merit. Very little that is written on this subject is worth reading, as apologists seem to control all publicity. The road to railroad bankruptcy has been a long one, and many gay buccaneers have ridden the investing public "high, wide and weary."

There is one book that will inform all engineers how the patient became so sick—Henry Clews' "Twenty-eight Years in Wall Street." This book contains the early history of the case. Read all about the mess that Uncle Dan'l and all of his kind have left us to clean up.

Section V of Mr. Baker's article, "The Danger of Too Centralized Control," deals with one of the most important phases of this question, and the present centralization is causing the collapse of the Interstate Commerce Commission by sheer weight of unfinished and "unknowable" business.

The railroad systems of this country are divided into two general areas—lines east and lines west of Chicago, St. Louis and the Mississippi River. If the Interstate Commerce Commission were divided into two equal parts we might hope for some constructive suggestions from it—the eastern division of the I. C. C., to have its headquarters in Washington, and the western division to have its headquarters in Kansas City.

The railroads to all practical intents and purposes are all one. The day of railroad competition is

over; "the eggs are scrambled," and there is no use in trying to bring back past conditions. The solution offered of public corporations is apparently workable, but of course every plan will be discredited as much as possible which does not originate with Uncle Dan'l's nephews. Mr. Baker's article suffers by condensation. The topic and point of view are worthy of much ampler treatment and elucidation. If it were in book form, the number of public corporations could be outlined, etc.

Some years ago a prominent London financier said that he had no interest in an American railroad until it had been in bankruptcy. Let us all hope that *finis* has been written to the long, sordid chapter from the Erie to the New Haven. FRANK W. HARRIS.

Olympia, Wash.

The Comedy of an Error

Sir—The publishers and authors of "Field Engineering" thank Antonio Llano for discovering and reporting to them some months previously the error noted in *Engineering News-Record* of Nov. 27-Dec. 4, 1919, p. 962. While the error is strictly typographical, it is none the less serious. The mistake occurred in the first edition of "Searles" and extends through the fifty-ninth thousand. In September, 1919, the writer directed that the plate be corrected.

It is the writer's desire to have all text and reference books with which he has to deal free from error. Errors in his own works are immediately corrected in the plates, whenever found or reported, and when he finds errors in other books he notifies the authors or publishers. HOWARD CHAPIN IVES.

Worcester, Mass., Polytechnic Institute.

[It is an interesting subject for speculation whether the error in question would not have been corrected many years ago if all engineers followed the commendable example of Mr. Llano and of Professor Ives in notifying authors and publishers of errors in— The editor had got this far in his comment when the following letter came to his desk:—EDITOR.]

Sir—Twenty-five or twenty-six years ago the misprint in Searles' "Field Engineering," giving the log versed sine of 87°33 as 9.881026 instead of 9.981026, as you noted last week, caused an amusing and exasperating occurrence on the E. & A. division of the Pennsylvania Co. At that time the E. M. W. corps (the writer transitman) were re-running and putting spirals on a main-line curve just west of Greenville, Penn., a curve about a thousand feet or so long, a job that should take about a half day. We got the curve "dope," set the point of spiral curve and point of compound curve at each end, then staked out the middle or circular part of the curve. The angles closed O.K. but the chaining would not check—some 3 ft. out, as I recall it.

Two of us had "figured" the curve, so we jumped on the chainmen, and sat in the shade while they were finding their "bust." They reported the chaining O.K. So Buddy and I refigured the curve. *All O.K.* Then we reasoned with the chainmen, without gloves, and Buddy and I took the chain to show the boys how a curve should be chained and to be a lasting example to them of how to find material errors in chaining. Their chaining proved to be right, and the corps spent the rest of that day first checking the calculations, then checking the chaining. These simply would not agree, so we took the late train back to headquarters. There the assistant engineer, a martinet, wanted to know whether that Greenville curve was staked. "No, sir." "Well, you are taking too much time for it." "Be sure to finish it in the morning and get in at noon." "Yes, sir."

I spent that evening checking over the calculations from every point, still finding them right. I went out the next day determined to find the "bull" in the field-work. All day it was the same old story, check calculation, check field work, till Buddy and I concluded we had gone crazy.

That night the assistant engineer "blew up" and we all certainly got ——. When he stopped for breath I stated the case to him, and decided to get out. It was not safe around there.

The morning of the third day, behold the corps, and the assistant engineer, at work on the curve, the assistant engineer being given all the rope he wanted and directing the whole job minutely. Still no check. Did we work hard all day? We did.

Going home in the train that night, as almost the last point of attack, I suggested to the assistant engineer that the tables of logs in Searles *were wrong*. He had about used up all his explosive material, but I got some slight reaction with that remark, so I went on into another car. There I took out "Searles" and had a general look at each log we had used. When I came to the log vers of 87°33 (one of our angles) Bingo! The first figure of the mantissa had been running 9-9-9; then for 87°33 it was an *8*; then followed 9-9-9. *The mystery was solved.* The calculations and field work checked. At that time (1893) I notified the publishers of "Searles" of the error, so Antonio Llano will not get any quick action.

It is only fair to say that it is a billion to one shot that this is the only misprint in the Searles log tables. I would stake my life on their accuracy any day if necessary, after thirty years of use.

New Castle, Penn. G. B. ZAHNISER.

[That publishers are more alert now than they were a quarter century ago is indicated by Professor Ives' statement that no time was lost in correcting the error in the plates. It is still an interesting subject for speculation how many times the error in question was discovered since the first edition of "Searles" was published, and what percentage of those who found it took steps to have it corrected.—EDITOR.]

Why Not Engineers on Industrial Committee?

Sir—The President has appointed a new committee whose duties are to attack the cost of living, and in the specific instance of industrial disputes to suggest solutions. This is a great work, and one which should be well done, for it is difficult to overestimate its potential good.

Comments by authorities on the composition of this committee have, as far as noted by the writer, been quite favorable. The many sides of the public mind are presumably well represented.

But are the best interests of the country well cared for when out of so small a group at least eight are lawyers? Why not more engineers, the men who build and operate the railroads, steamship lines and the physical cities and are the "go betweens" for the restless employee and the equally disturbed employer? True, the vice-chairman, Mr. Hoover, is an engineer, but the profession has many men his equal, and the writer

doubts that the best interests of the country are ever served in times of stress by the legal mind, which is not progressive and must have, for a crutch, a precedent upon which to function.

W. M. BUTTS,
Wendell M. Butts & Company, Civil and Mechanical Engineers.
San Francisco, Cal.

On the Alliance of the A. S. M. E. With the Industrial Conference

Sir—Your reference in your Oct. 23 issue to the American Society of Mechanical Engineers' alliance with the Industrial Conference Board was read with a great deal of interest by the writer, and I heartily agree with your point of view, which takes the same position as that of Morris Llewellyn Cooke in this matter.

The American Society of Mechanical Engineers should not be anti-labor or anti-capital, but should serve society as a whole, the public, as well as capital and labor. We should seek to be a balance wheel in these matters. Therefore, if we do not become entangled by alliances with either side we are in a much better position to serve the community as a whole. When I say the "community as a whole" I mean both capital and labor and the public.

As a member of the American Society of Mechanical Engineers I have taken this view, and also sent in my protest against our membership in the National Industrial Conference Board.

Your attitude regarding other societies aligning themselves with the Chamber of Commerce of the United States, etc., are well taken.

C. W. KOINER,
General Manager, Municipal Lighting Department, City of Pasadena.
Pasadena, Cal.

Drainage Works Maintenance in Minnesota

Sir—Your editorial on "Maintenance of Land Drainage Systems" (Oct. 16, 1919, p. 718), touches on a subject of vital concern to all drainage officials, and, it is hoped, will elicit a wide discussion.

Minnesota enacted in 1905 the first law outlining proceedings for the construction of drainage ditches within the state. This statute included a very general reference to the subject of repair and maintenance of drainage structures, by making it the duty of the boards of county commissioners to keep in repair all drainage improvements within their respective counties, and outlined a method of procedure to be followed in assessing and collecting the costs of doing the work.

The section of the law relating to repairs has been amended at every session of the legislature but one since its enactment, and I believe an honest effort has been made to seek out an efficient way of keeping public drainage ditches within the state in proper repair. The writer believes, however, that there is yet much to be accomplished along this line.

The causes which lead to the necessity of repairing drainage ditches are nearly always the caving-in of banks, the placing of obstructions in the ditch by careless and thoughtless settlers to afford temporary crossings or watering places for stock, the falling in of trees, etc. If funds were provided and it were made someone's duty to take immediate action to remedy these defects before the far-reaching effects caused by the lodging of silt and débris behind such obstructions had made necessary a formidable and expensive repair job, much expense and inconvenience could be saved the taxpayer.

The difficulty with placing the work of keeping ditches in repair with the county boards is obvious. It becomes no one's special duty to look after the smaller obstructions and defects before they have been the cause of sufficient mischief to cause some one individual or a number of individuals to demand action from the board. By the time the board has examined into the matters complained of and has authorized repairs, the drainage ditch in question has probably been so badly obstructed that to put it in its original condition will cost from 25% to 75% of its original cost.

The Minnesota legislature of 1917 authorized the boards of county commissioners of counties wherein drainage ditches costing in the aggregate $50,000 or more had been constructed to appoint a county ditch inspector (no qualifications) "whose duty it shall be to travel over the line of all such county and judicial ditches . . . . at least twice each season and inspect the same, observe . . . . what repairs . . . . may be necessary or proper, and immediately thereafter he shall make a full report in writing to the county board of his work, together with the estimate of the cost thereof," etc. It is then made the duty of the county board to act on the county ditch inspector's report at the "first meeting of the board following the filing of said report."

While providing for the appointment of an inspector may be a step forward, the effects of this provision will be far from hitting the vulnerable point—namely, securing immediate action at any time it might be found necessary and providing a fund, always available, from which to pay for minor emergency repairs. The removing of a load of hay placed intentionally or accidentally in an open ditch should not be made to await the filing of an inspector's report and a further delay for action on the report by the county board at its next following meeting. Neither should the crumbling of a bulkhead or the temporary obstruction of a costly underground tile drain be allowed to cumulate damages for a period of from one to five weeks awaiting favorable action and authority to repair from the county board. The old adage, "A stitch in time saves nine," can be no more forcibly demonstrated than in the immediate removal of obstruction from drainage ditches.

To provide for such a method of repairing drainage ditches the writer suggests:

1. The appointment of a qualified drainage engineer in each county of the state where drainage construction is a considerable factor of development, whose duty it shall be to supervise the repair and maintenance of drainage construction.

2. Authorizing the levying of a small annual tax—call it a sinking fund—upon all lands benefited by drainage, to meet the cost of keeping the systems in repair so that there will be funds available at all times.

3. Giving authority to the ditch inspector to expend for emergency repairs a sum not to exceed a certain amount for each such emergency job. Jobs requiring expenditures in excess of such stipulated amounts to be done only at the orders and by the authority given by the board of county commissioners.

E. V. WILLARD,
State Commissioner of Drainage and Waters.
Saint Paul, Minn.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Rod Readings in Tunnel Speeded Up By Can-and-Candle Device

A SIMPLE device used by the San Joaquin Light and Power Co. on the work under way at Auberry, Cal., has saved time in making direct readings on a rod in tunnels or where artificial light has to be used. Its purpose is to illuminate the figures on the rod at any height, by means of which the rodman can speedily change from one height to another.

The device consists of a gallon can with two holes made in its sides near the bottom large enough to thrust the rod through, the target having first been removed. The can is put on the rod with its bottom in a vertical plane, leaving the face of the rod visible through the open top of the can. The top is not entirely cut out of the can, just enough being left at one side to shield a candle fastened there. Thus, the candle illuminates the figures without shining directly toward the observer. The can is raised and lowered by means of a string passing from the can to the top of the rod and back down to a convenient height. In lieu of a pulley at the top of the rod the string is passed over the thumbscrew which is ordinarily used for setting the target.

Dragline Excavator Loads Scows Anchored in Channel It Dug

BY A. I. SILANDER
Civil Engineer, Chicago, Ill.

AN UNUSUAL employment of a dragline excavator is being successfully demonstrated at North Evanston, Ill., as is indicated by the accompanying drawings. The National Brick Co. is under contract with the Sanitary District of Chicago to remove the clay spoil banks along the north channel. The National Brick Co. bought from the contractors, Shnable & Quinn, the excavator that dug this channel.

Fig. 1 shows a cross-section of this channel and one spoil bank, with the position of the 100-ft. boom excavator and the 30 x 100-foot deck scow.

The excavator travels parallel with the channel and heads into the spoil bank. The current in the channel is used in spotting the scow. In dumping, it is found by the operators of the apparatus, this bucket loads the scow without any jar or impact.

Fig. 2 shows a section parallel with the channel and shows also the digging slope with reference to the excavator. The bucket digs down hill and above the base of the excavator as successfully as it dug up hill and below the base of the excavator. After a cut has been completed, and just before moving up, the operator places a loaded bucket in the position shown, then, by dragging it in the direction of the arrow, he pushes away from himself the ridge or roll that accumulates in front of the excavator. By repeating this operation five or six times he cleans and trims up a 30-ft. pathway necessary for laying the next section of runway plank. The ridges outside of this pathway are picked up back of the excavator in passing them.

The Sanitary District is represented by G. M. Wisner, chief engineer, and by William Sullivan, resident engineer. The National Brick Co. is represented by C. J. Weber, general superintendent.

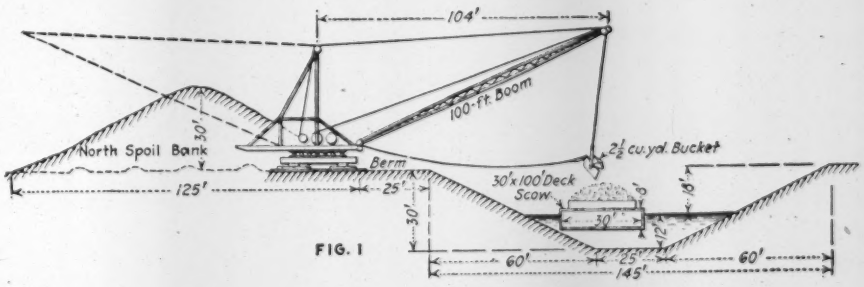


FIG. 1

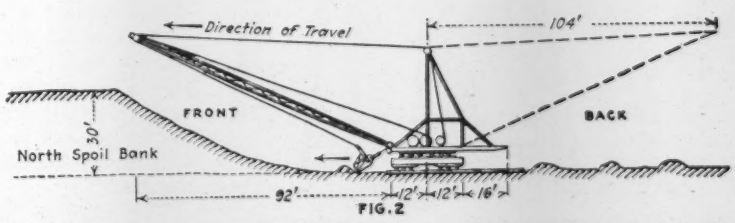


FIG. 2

WIDE RANGE OF EFFECTIVENESS OF DRAGLINE EXCAVATOR SHOWN ON SANITARY CANAL JOB

Convenient Support for Trolley Wire in Tunnels

IN DRIVING the tunnels for the Kerckhoff power plant, the San Joaquin Light and Power Co. of Fresno, Cal., is using electric locomotives operating at 250 volts d. c. If the trolley wire is left in place while the shots are fired, wire and supports are always damaged more or less, so that it has been found desirable to take it down, for each shot, for about 200 ft. back from the heading.

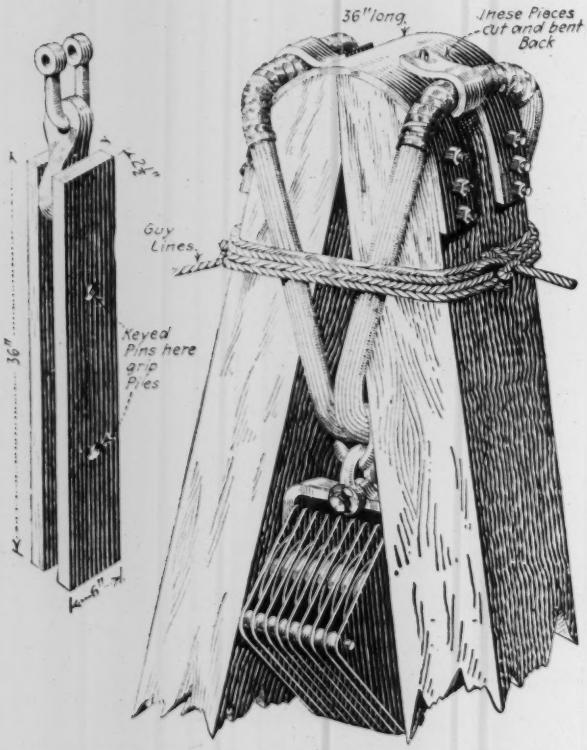
A plan for supporting the trolley wire which has been found very convenient in work of this sort is to drill holes at suitable intervals in the wall of the tunnel near the roof and to slip into these short pieces of 1¼-in. pipe. These fit nicely the standard drill size used on the job. The insulator for the trolley wire is carried on a sleeve or slip ring which can be slipped over the end of the pipe and fastened at the desired point by means of a setscrew.

The advantage of this plan is in the ease and speed with which the trolley line can be taken down. At the first few supports near the heading the pipes as well as the slip rings are removed, in preparing for a shot. Farther back the pipe is left in place, the slip rings being loosened and slipped off so that the wire can be rolled up out of the way. The insulator carried on a sleeve, as used on this job, is a standard article, comparatively inexpensive. The pipe is required only in short pieces, such as can usually be cut up from scrap.

A-Frame With 15-Part Line Used For Pulling Steel Sheet Piles

STEEL sheet piles of the Lackawanna type are being pulled from about an average 40-ft. penetration with a specially devised A-frame rig, on the Queenston-Chippawa power canal of the Ontario Hydro-electric Power Commission. One of the bridges here is to carry an interurban electric railway across the canal, but it was built inside a sheeted excavation before the canal was dug. Now that the bridge is finished, the piles are being pulled before the canal has been dug up to the bridge walls.

The rig comprises a heavy A-frame held by guy lines in slightly inclined position over the piles to be pulled, and carrying from the specially designed headframe the two-block 16-part line, at the bottom block of which is attached the pile-pulling grip. The frame is made up by 12x14-in. sticks heavily braced at the bottom and about 10 ft. from the bottom. The headpiece is a 6x1-in. steel plate bent over the curved top, as shown in the sketch herewith, and with interior loops made by cutting the plate as shown in the sketch and bending

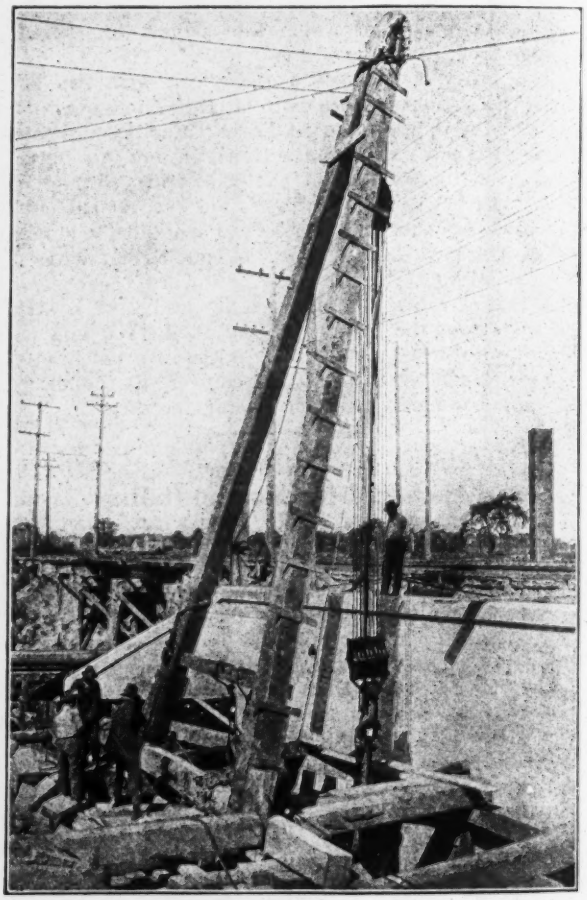


DETAILS OF A-FRAME PILE PULLER IN NIAGARA FALLS POWER CANAL

over and riveting down on the top. In these loops hung wrapped cables which carry the top blocks. Just below the top band the guy lines are wound three or four times around the frame.

The superintendent in charge of the job states that the rig would be more effective if the frame were more thoroughly braced, both with crossbraces and with a heavy wedge block in the crotch, and also that there should be hardwood blocks tacked onto the outside of the frame sticks underneath the guy-line binding.

In the first efforts to pull, an ordinary clevis was used with a pin through a hole cut by a gas flame in the



PULLING SHEET PILES ON THE QUEENSTON-CHIPPAWA POWER CANAL NEAR NIAGARA FALLS

top of the sheet pile. This soon pulled out the pile web, so the grip shown in the accompanying sketch was devised. This consists of two 3-ft. plates 6 in. wide, hanging from the lower block, with two 2½-in. holes through which the pile is gripped by keyed pins passing also through holes cut by a gas flame in the top of the pile to be pulled. This jaw gives a long, frictional grip on the pile; this has proved very effective. In pulling, the frame has to be braced against timbers as shown. It is easily slid along these timbers from pile to pile as required.

The work is in charge of J. B. Goodwin, who is works engineer, with A. C. D. Blanchard, the chief field engineer.

NEWS OF THE WEEK

New York, January 1, 1920

President Proclaims Return of Railroads March 1

Says Serious Complications Would Be Faced if Properties Went Back on First of Year

By a proclamation issued Dec. 24 the President announced that the railroads and express companies would be returned to private operation Mar. 1, 1920. The President's proclamation was accompanied by a statement issued from the White House that, under existing conditions, it was thought better to postpone the return of properties from the first of the year, in order to avoid legal and financial complications.

The President's proclamation follows:

Whereas, in the exercise of authority committed to me by law, I have heretofore, through the Secretary of War, taken possession of and have, through the Director General of Railroads, exercised control over certain railroads, systems of transportation and property appurtenant thereto or connected therewith, including systems of coastwise and inland transportation, engaged in general transportation and owned or controlled by said railroads or systems of transportation, including also terminals, terminal companies and terminal associations, sleeping and parlor cars, private cars and private car lines, elevators, warehouses, telegraph and telephone lines, and all other equipment and appurtenances commonly used upon or operated as a part of such railroads and systems of transportation; and

Whereas, I now deem it needful and desirable that all railroads, systems of transportation and property now under such Federal control be relinquished therefrom:

Now, therefore, under authority of Section 14 of the Federal Control act approved Mar. 21, 1918, and of all other powers and provisions of law thereto me enabling, I, Woodrow Wilson, President of the United States, do hereby relinquish from Federal control, effective the first day of March, 1920, at 12:01 o'clock a.m., all railroads, systems of transportation, and property, of whatever kind, taken or held under such Federal control and not heretofore relinquished and restore the same to the possession and control of their respective owners.

Walker D. Hines, director general of railroads, or his successor in office, is hereby authorized and directed, through such agents and agencies as he may determine in any manner not inconsistent with the provisions of said act of Mar. 21, 1918, to adjust, settle and close all matters, including the making of agreements for compensation, and all questions and disputes of whatsoever nature arising out of or incident to Federal control, until otherwise provided by proclamation of the President or by act of Congress; and generally to do and perform, as fully in all respects as the President is authorized to do, all and singular the acts and things necessary or proper, in order to carry into effect this proclamation and the relinquishment of said railroads, systems of transportation and property.

For the purposes of accounting and for all other purposes this proclamation shall become effective on the first day of March, 1920, at 12:01 a.m.

At the same time Director General Hines issued a message to railroad officers and employees under Federal control, urging redoubled efforts to produce "the best and most economical railroad service possible during the remaining period of Federal control."

(*Concluded on page* 59)

Short Assignment for Chief of Engineers

(*Washington Correspondence*)

While the Secretary of War declines to make any prediction concerning when he will make his recommendation for the appointment of the Chief of Engineers, U. S. A., it is understood that he does not intend to make a recommendation which would place an officer at the head of the corps for a much longer period than the average tenancy. In the case of Col. Henry Jervey, for instance, 10 years would elapse before he becomes of retirement age. Col. W. C. Langfitt, if appointed, would hold office 4½ years, while Col. F. V. Abbot, if he should be the successful candidate for the post, would serve about two years.

A. A. E. Gets 5000 Applications in Two Weeks' Drive

More than 5000 applications for membership were received as a result of the Dec. 1-13 drive of the American Association of Engineers. The results are not yet tabulated, as the returns are not yet all in, but it is believed at the association's headquarters that the membership increase will be considerably in excess of that figure. The highest percentage of increase over existing chapter membership was that of Buffalo, which up to Dec. 20 was in excess of 300 per cent.

Safety Codes Referred to Engineering Standards Committee

As a result of a conference of organizations interested in uniform safety codes, held at Washington on Dec. 8 and 9, 1919, upon invitation of the Bureau of Standards, the American Engineering Standards Committee will be asked to assume direction of the drafting of safety codes.

The conference supplemented one held on Jan. 15, 1919, when a discussion took place that led to proposals for transforming the standards committee as then constituted into an association. Several months later the association proposal was laid before the founder societies of the committee in the form of a revised constitution, but the opposition to this led to its failure. In the meantime a vote of safety organizations was instituted by the Bureau of Standards, acting for the safety conference, to determine whether the safety-code work were best handled by an independent organization or by the standards committee. The vote went about three to one in favor of the latter alternative.

To Hold Public Works Meeting in Washington

Association Convention January 13-14 To Discuss Campaign Work for New Year

The National Public Works Department Association (formerly the Engineers, Architects and Constructors' Conference on National Public Works) will hold its convention in Washington, D. C., Jan. 13-14, 1920, to discuss the status of the campaign to date and make plans for the new year. A statement of purposes will be made. It is intended to initiate an intensive program.

On the first day of the meeting, after the report of the executive and finance committees, a communication from Gov. Frank O. Lowden of Illinois on "What a Department of Public Works Has Done for Illinois" will be presented. In the afternoon session, reports concerning campaign procedure will be made, and discussion will be open. The Jones-Reavis bill will be discussed by sections, with suggestions for amendment. Representative Reavis will address the meeting on the practical results to be achieved by a United States Department of Public Works, and Gen. R. C. Marshall, chief of the Construction Division, on "Practical Economies Secured by Standardization of Construction Activities."

On the second day of the meeting, "state teams" will confer with members of Congress previous to presenting their reports. Finances will be discussed, and the report of the committees on new organization, nominations, and resolutions will be presented.

Contractors To Hold Annual Session in Chicago

The annual meeting of the Associated General Contractors of America and affiliated organizations will be held in Chicago, Jan. 21-23, 1920. One of the features of the meeting will be a two-day national conference on construction problems, to be held in connection with the business sessions of the association and open to all general contractors, whether members of the A. G. C. or not. The first day of the conference will be devoted to a consideration of industrial relations, and means of greater production, and on the second day the conference will divide into four large groups, representing (1) building contractors; (2) highway contractors; (3) railroad contractors, and (4) public-works contractors, to discuss special problems of interest to these groups.

The business sessions of the annual meeting will be devoted to a discus-

sion of the work of the association during the past year, as presented in the reports of the standing committees; to the election of officers; and to mapping out a program for the coming year. The annual banquet will be held Jan. 22.

At a meeting of the executive board of the association recently in New York, the report of the nominating committee was received. The following were proposed: For president, Frederick L. Cranford, president of Frederick L. Cranford, Inc., New York City; first vice-president, T. T. Flagler, president of the Flagler Co., Atlanta, Ga.; second vice-president, J. W. Cowper, president of the John W. Cowper Co., Buffalo; third vice-president, W. O. Winston, president of the Winston Bros. Co., Minneapolis; treasurer, C. F. Mullen, secretary and treasurer of the Masters & Mullen Construction Co., Cleveland. For members of the executive board (the terms of four of whom expire in January, 1923), R. T. Collins, Jr., Cumberland, Md.; Walter Cahill, Great Lakes Dredge & Dock Co., Chicago, Ill.; A. P. Bent, Bent Bros., Los Angeles, Cal., and George Watson, the Watson Co., Dallas, Tex.

Illinois Section, Am. Soc. C. E., Discusses Development Report

In a discussion, Dec. 19, 1919, of the development committee report of the American Society of Civil Engineers, at the annual meeting of the Illinois Association of Members of the Society, John W. Alvord, head of the analysis committee of the board of directors, outlined an alternative plan for the nontechnical activities. He would broaden and make more representative Engineering Council by having its membership made up mainly of the regular officers elected by the constituent societies and also of delegates from regional associations of societies. A biennial assembly of the estimated 127 members would handle the larger questions and appoint an executive staff or committee as the working body.

Closer coöperation of the association with the Western Society of Engineers will be effected, and combined technical meetings held, if provisions of a report submitted by A. J. Hammond are voted upon favorably in a forthcoming letter ballot. Informal vote was favorable to the idea. Former activities have been confined to nontechnical affairs.

The officers elected for the coming year are as follows: Albert F. Reichmann, chairman; A. J. Hammond, vice-chairman; W. D. Gerber, 913 Chamber of Commerce, Chicago, secretary-treasurer.

Simplon Traffic Diverted To Avoid Avalanche Danger

Exceptional avalanche conditions in Switzerland during the last two weeks of December led to fatalities and the temporary abandonment of railway traffic through the Simplon tunnel, because of threat of slides along both approaches.

Spanish Engineers Urge Big Public-Works Program

Four Thousand Attend National Congress—Public-Works Minister Recommends Expenditure of $601,800,000

(From "Engineering News-Record" Correspondent in Madrid)

The National Congress of Engineers completed Nov. 25 in Madrid the most important conference of technical, industrial and economic leaders that has ever been assembled in the history of Spain. The gathering of more than 4000 engineers and industrial authorities afforded a means of summing up the experience gained in the extensive expansion of Spanish industries brought about during the world war, and gave expression to authoritative conclusions concerning the economic development of Spain in the immediate future. The liberation of the country from dependency on foreign markets for the necessities of economic life was one of the dominating ideas of the congress. The necessity of economic independence from a military point of view was strongly emphasized. The representatives of the army and navy coöperated with civilian technical authorities in developing the plans whereby the industries of the country could most readily lend themselves to national defense. The most important action recommended as an economic-military expedient was the intensive development of mineral resources. Reforestation and agricultural development were cited as other works needed to place the country on a formidable military basis.

The conclusions and recommendations approved by the congress involved:

Governmental financial and legislative aid in the solution of the railroad problem.

A standard gage for all the railroads of Spain.

Creation of a permanent commission to study the standardization of materials, units, and conventional signs used in the mechanical industries and construction.

Establishment of a national testing bureau for machinery, materials of construction, and industrial products.

Increased transportation facilities to the mining districts.

A complete mineral survey of Spain.

A complete survey of the hydro-electric possibilities of the peninsula.

Construction of a network of power transmission lines for the distribution of hydro-electric energy over the entire country.

Increased expenditures on the maintenance of highways.

Construction of more roads into the forest regions for the removal of forest products.

Regulation of the construction of habitations for all classes of society.

Formation of commissions of employers and employees to harmonize industrial relations.

Industrial profit-sharing plan to apply to laborers and administrative forces.

Formation of a Sanitary Engineering Section in the next Congress of Engineers.

Postponement of legislation concerning public works until the Government shall have had sufficient time to make use of the studies made by the Congress of Engineers.

BIG APPROPRIATION RECOMMENDED

That the deliberations of the congress will be of immediate practical value to the nation was demonstrated in the closing session, which was presided over by the Minister of Public Works of the National Government. He announced that, in accordance with the conclusions of the Congress of Engineers, he is recommending to the Parliament the expenditure of $601,800,000 (3,009,000,000 pesetas) during the next ten years for the economic-industrial development of the country. It is recommended that the greater part of this amount be apportioned as follows:

$254,000,000 for the extension of the railroad system;

$193,000,000 for highways;

$48,600,000 for ports and navigation signals;

$14,000,000 for agricultural development and education;

$19,000,000 for reforestation;

$10,000,000 for a mineral survey of the country, laboratories of mineral analysis, and subsidies to mining industries.

The minister recommended that these funds be raised in such manner that future generations may bear a part of the expenditure. He will include in the bill of proposed legislation a revision of the present laws concerning hydro-electric concessions providing that the ownership of these power enterprises revert to the state after a specified interval, and that the Government share in the profits realized.

The Congress of Engineers was held under the auspices of the Institute of Civil Engineers of Madrid. Its success was largely due to Sr. Frederico La Viña, former president of the Institute, Sr. Francisco Teran, present presiding officer, and to Sr. Juan A. Perez Urruti, secretary-general of the congress. The convention enjoyed a large representation from the industries of the country and from various economic societies. The king took a very active interest in the proceedings. He visited the sessions and entertained the members of the congress in the royal palace. An industrial exhibition was held in conjunction with the congress, Nov. 16-25. It is undecided yet as to the date on which the next gathering of the congress will be effected, but it is generally estimated as five years hence.

The congress was called at a very opportune time, a time when Spain has not only the will but the financial means for extensive public undertakings. Notwithstanding the labor unrest, which is evident in nearly all countries, the conclusions of this congress of engineers seem to have expressed the national consciousness.

President Proclaims Return of Railroads March 1

(*Concluded from page* 57)

ming period of Federal control of the ilroads."

In his message cabled to Congress st spring and read before both ouses May 20, the President said: The railroads will be handed over to their owners at the end of the calendar year." There had been some belief that the intention would actually be carried out, in spite of the fact that Congress had not passed a final bill. The President's action in naming March 1, 1920, as the date of return to private operation has met with general approval of corporate and Federal railway officers and leaders of Congress, including the House and Senate conferees who have before them the task of reconciling the differences of the Cummins and Esch bills.

Railroad Bills Go to Conference

With the passage of the Cummins bill in the Senate Dec. 20, the House and Senate Conference Committees began Dec. 23 the task of formulating a final measure, faced with the necessity of the enactment of a bill before the return of the railroads March 1 as proclaimed by the President. The Esch bill, passed by the House, differs from the Senate measure so vitally that the task is considered very difficult.

For the Senate the conferees are Messrs. Cummins, Poindexter, Kellogg, Pomerene and Robinson, and for the House they are George Esch, Edward L. Hamilton, Samuel E. Winslow, Thetus W. Sims and Alben W. Barcley.

In the meantime, labor interests are opposing the anti-strike features of the Cummins bill, and the railway machinists have threatened to walk out if these measures are adopted.

It is expected that it may be necessary for Congress to take actual votes on some of the principal points at issue before the conferees can render a final report. Under the rules of conference, provisions of either bill may be thrown out or altered but new material may not be introduced, although the rules are sometimes violated.

Plan To Pour Concrete on Hetch Hetchy Dam Next June

In a recent address before the San Francisco Association of Members of the American Society of Civil Engineers, M. M. O'Shaughnessy said of the Hetch Hetchy dam: "The foundation has been unwatered by means of a log crib dam 40 ft. high, 300 ft. upstream from the main dam. This turns the water of the river into the diversion tunnel, which is 23 x 25 ft. in section and 900 ft. long. A dam 25 ft. high just above the tunnel outlet prevents the water from backing up into the unwatered site. A steel caisson 120 ft. long in three sections has been arranged to be sunk immediately above and adjacent to the foundation of the main dam on the upstream side, so that the bottom can be entirely unwatered. It is hoped to have this work done by next June, when the foundation concrete will be poured."

The Hetch Hetchy dam contract, as was noted in *Engineering News-Record* of Aug. 7, 1919, p. 292, was awarded to the Utah Construction Co., July 31, under terms requiring its completion within three years.

Would Draw More Water From Niagara

Proposals for a new treaty between this country and Canada to provide for the withdrawal for power purposes of an additional 60,000 cu.ft. per second from the Niagara River above the Falls have been made to the State Department of the United States by Representative Clarence MacGregor, of New York. Under the present treaty the diversion of water for power purposes is limited to 36,000 cu.ft. per second by Canada and 20,000 cu.ft. by the United States. Under the treaty as proposed by Mr. MacGregor each country will be given 30,000 cu.ft. more than it has at present. The agitation for a new treaty will doubtless be seconded in Canada by the Hydro-electric Power Commission of Ontario, which, as noted in *Engineering News-Record* of Dec. 11-18, 1919, is now building a new project which will divert 10,000 sec.-ft. from above the Falls. On account of the greater efficiency of the use of the head and flow through this project, the commission will want to utilize it to its full capacity, but in so doing it will have to shut down several of the existing plants, on account of the restrictions of the Canadian use to the 36,000 cu.ft. per second which is now practically all being utilized in existing plants.

Chimney Construction Companies Indicted

In New York City on Dec. 17 a Federal Grand Jury indicted five chimney construction companies and more than a dozen of their officials on the charge of having organized and operated a trust for the construction of radial brick chimneys in violation of the Sherman anti-trust law. The indictment accuses the dependents with having sought to restrict the business of those allied with the defendant corporations, to fix prices, and to prevent competing concerns from using the same materials and methods in chimney building. It is charged that the Chimney Builders' Association was incorporated in 1914, and that the members agreed to send to the secretary of the association written information of every inquiry received from prospective customers, and to state each quotation or bid submitted. The companies indicted are the Alphons Custodis Chimney Construction Co., the M. W. Kellogg Co., H. G. K. Heinicke, Inc., Bergen & Lindeman, Inc., and the Heine Chimney Company.

French Reconstruction Not for United States Engineers and Contractors

(*From "Engineering News-Record's" Correspondent in Madrid.*)

Very little of the reconstruction of war-devastated regions of France is being done by American engineers and contractors. A recent investigation in France by *Engineering News-Record's* representative shows that one American corporation, having a permanent branch office in Paris, is working on contracts in Alsace for the rebuilding of three small cotton mills, the aggregate of the work running under $50,000. Another United States firm of contractors is occupied on similar small jobs, the bulk of the material for which is being purchased in France.

It seems unlikely that there will be many bulk contracts given for the reconstruction of whole towns or of large areas. The present construction is being done not directly for the French Government but for individual property owners in piecemeal lots. According to the French representatives of two American contractors, there is plenty of work for American concerns which are willing to finance their own work and wait for payment until the German indemnity is paid to the French Government and in turn handed over to the individuals who let the contracts. It may mean a long wait for the money.

It is the opinion of some American engineers now in France that engineers trained in the school of American practice are unsuited to European methods of construction. They have many humorous stories to tell concerning their collisions with the French idea of the way things should be done. Frequently, in dealing with the individual property owner, consideration must be taken not only of the Frenchman's own opinion of the way in which his house should be built, but of the opinions of his father and grandfather before him. However, there is no attempt by these Americans to disparage the work that the French engineer turns out.

The French wish to use their own engineers as extensively as possible. At the present time there is almost no demand for Yankee technical talent in France, and the probability is that there will be no such demand in the next few years. Due to a lack of capital and, to a certain extent, to the labor situation, the reconstruction has proceeded very slowly.

Montana Highway Engineers Meet

The Montana Highway Improvement Association held a meeting in Butte, Dec. 6, for the purpose of consolidating various district organizations into one state body. The organization decided to employ a salaried manager, who will devote his entire time to the management of the affairs of the association. Headquarters of the 11 districts will be established at Missoula, Great Falls, Helena, Butte, Havre, Roundup, Boze-

man, Billings, Miles City, Glendive and Glasgow. Nelson Story of Bozeman was elected president of the consolidated organization and J. A. Harader, Bozeman, secretary.

The next meeting will be held in Billings, Jan. 10, 1920, when the State Highway Commission will meet with the association.

Turner Company Gives Insurance Policies to Employees

At the recent annual dinner of the Turner Construction Co., of New York, held in the ballroom of the Hotel Commodore and attended by 600 of the 800 straight-time employees, Henry C. Turner, president of the company, announced that the board of directors had decided to give all employees paid by the week or month, who had been one year with the company, life-insurance policies with premiums paid by the company.

James E. Kavanaugh, vice-president of the Metropolitan Life Insurance Co., explained the group insurance plan under which the policies were to be issued: To each employee of one year's service, $500, and $100 for each additional year up to a total of $2000. Foremen who have been with the company five years will receive $1000 as the initial amount of insurance. Others will receive amounts according to length of service.

Commerce Bureau Creates New Western European Division

The formation of a Western European Division to meet the growing and insistent demands of American business for facts concerning what is now the key situation in world trade was announced Dec. 5 by Philip B. Kennedy, director of the Bureau of Foreign and Domestic Commerce. For the present the new division will devote itself to England, France, Belgium, and possibly Holland.

The large volume of industrial, financial and commercial inquiries relating to western Europe have heretofore been handled by experts connected with various units in the bureau, but the mass of information now coming in from the many special investigations conducted during the summer and autumn, and the outstanding importance of the situation in western Europe as a factor in future commercial developments, have made it necessary to expand the facilities for handling the work and to center them.

The Western European Division will be in charge of F. W. Powell, who has just returned from England after completing a study of reconstruction in English industry, a report on which will shortly be published. Mr. Powell was connected with the War Trade Board during the war, and previous to that time was engaged in economic research. The division will be organized and conducted along the lines of the Latin-American, Far Eastern, and Russian divisions of the bureau.

Progress in Adjusting Railway Engineers' Salaries

Information concerning recent developments in the adjustment of compensation for railroad professional engineers has been gathered by the American Association of Engineers, which affords the following description of conditions in five regions:

Southwestern Region — Adjustments were made by the regional director, effective Nov. 1. While it is too early to determine just what increases are made, information from the St. Louis & San Francisco and the San Antonio & Aransas Pass indicate an average increase of $25.

Pocahontas Region—The regional director early in December stated that adjustments have been made on the Norfolk & Western and that one is being considered for the Chesapeake & Ohio and for the Virginian.

Allegheny Region — It is indicated that adjustments, effective Sept. 1, covered the Pennsylvania Lines, West, fairly well. A few departments of the Baltimore & Ohio were also included, but no other railroad.

Southern Region — A committee of engineers met at Atlanta late in October and drafted a tentative schedule, following the submission of new data to the regional director by the A. A. E. Sept. 25. The tentative schedule has been submitted to each Federal manager, with the request for recommendation in accordance therewith.

Eastern Region—Data from 1410 new questionnaires were presented to the regional director Nov. 26. He stated that he would take the matter under consideration. The data indicated that adjustments effective July 1 covered less than half of the railroads and less than 35% of the positions, and that present salaries on many roads, particularly the Delaware & Hudson, Erie, and New England roads were very low.

The association reports that the Federal managers were stumbling blocks where no adjustments were made. Therefore, each railroad section has been asked to prepare and transmit to them through official channels a report giving detailed recommendations for the adoption of the A. A. E. schedule on their respective roads.

Conference on Concrete House Construction

In the third week in February, 1920, there will be held at the Auditorium Hotel, Chicago, a national conference on concrete house construction which will be accompanied by meetings of a large number of associated interests. Co-operating in the movement for the conference are the American Concrete Institute, the Associated General Contractors of America, the Concrete Products Association, the Portland Cement Association, the Illinois Society of Architects and Illinois Chapter of the American Institute of Architects.

During the same week the conventions of the American Concrete Institute, the Concrete Products Association, the Concrete Block Machinery Association and the American Concrete Pipe Association will also be held. The conference itself will last from Feb. 1 to 19, 1920, inclusive. The exact dates of the other meetings have not been set. Information regarding them can be obtained from the National Conference on Concrete House Construction, 111 W. Washington St., Chicago, Ill.

To Make Surveys in Sierras

Snow surveys covering the entire length of the Sierra Nevada range are to be made for the purpose of determining the water-supply available from the snow fields and of perfecting a system of stream forecasting and control in the interests of irrigation, flood control and river navigation. This work will be done by co-operative action of the States of Nevada and Cailfornia, the former represented by Prof. J. E. Church, Jr., of the University of Nevada, and the latter by Maj. Paul M. Norboe, assistant state engineer of California. Snow surveys of this kind, with Professor Church's work in Nevada, were described in *Engineering News-Record* of Oct. 23, 1919, p. 766.

Contractor May Forfeit Deposit Check

Rising prices may lead the Walsh Construction Co. of Davenport, Iowa, to forfeit a $10,000 guarantee check on a contract which it has been awarded. The bid concerns the first part of the construction of the Great Western Gateway Bridge over the Mohawk River, between Schenectady and Scotia, New York, being built under the direction of the State Engineer of New York over the Mohawk River and the New York State Barge Canal at Schenectady.

It is a very long and expensive structure, and the work was divided for contract into four parts, the first of which included the construction of the approaches and abutments. Bids were opened for this part on Sept. 12. The Walsh company's bid of $198,880 was accepted by the state. The County and City of Schenectady deposited their share of the cost soon after the bids were opened, but there was considerable delay in the issuance of the Scotia bonds, and the Attorney General of the state ruled that the contract could not be let until all the parties had deposited their shares with the state. This was not completed until Dec. 3. Meanwhile, the price of materials had gone up to such an extent that the Walsh company refused to accept the contract. It is stated that figures show that the cost has increased $17,000 since the bid was made and that it would be cheaper for them to sacrifice the $10,000 certified check than to continue the work on the bid made. Certain business men in Schenectady have offered the Walsh company $10,000 bonus to accept the contract, but this has been refused. Local papers now report the probable offer of a larger bonus.

Pennsylvania To Report Daily on Winter Condition of Roads

The Pennsylvania State Highway Department has announced that it has completed plans whereby all of the main connected hard-surface highways will be kept open for winter traffic, particularly those sections where motor trucks can be used for the transportation of farm products to the centers of population. In order to keep the roads open the department has purchased 10 snow-plow truck attachments in addition to the 16 already on hand. There are also 225 road machines, which are the property of the department, and which will be transferred to the main lines of travel. The district organizations will handle snow removal as they do the department's general maintenance operation.

The State Highway Department on Wednesday, Dec. 10, 1919, began making daily reports on road conditions to meteorologists of the weather bureaus in Philadelphia and Pittsburgh. These bureaus will in turn inform motor clubs, manufacturers and the public in general of the condition of the main connected hard-surface highways over which east-west winter traffic passes. This surface includes the Lincoln Highway between Philadelphia and Pittsburgh, the National Pike within the boundaries of Pennsylvania, the highway between Chambersburg and Harrisburg; the William Penn Highway between Harrisburg and Philadelphia, and the William Penn Highway between Reading and Easton. Each of these thoroughfares has been divided into sections. Superintendents in the various counties will mail each day to the weather bureaus and to the State Highway Department cards giving the condition of the roadways by sections. If any marked changes occur during the night, telegraphic reports will be made the following morning.

Examine Culvert Being Tested Under Deep Fill

As a result of the pioneer work being done by the Iowa State Experiment Station on the action of culverts under earth fills, a joint committee of engineers and manufacturers visited Ames Dec. 4, to study a culvert which is being tested under a deep fill and to study the data already collected for a report on the investigation. The Iowa station is the only organization in the country which has done any work along the lines of actually determining the effect of earth fills and live loads on highway and railroad culverts.

Of the members of this committee on reinforced-concrete culvert-pipe specifications the following were present at the Ames meeting:

G. H. Tinker, Nickel Plate Railroad Co., Cleveland; A. F. Robinson, Santa Fe Railroad Co., Chicago; J. L. Zeidler, Zeidler Pipe Co., St. Joseph, Mo.; C. F. Hunte, Concrete Products Co. of America, Pittsburgh, Penn.; J. E. Moody, Massey Concrete Products Corporation, Chicago; L. D. Hadwin, Chicago, Milwaukee & St. Paul Railroad Co., Chicago; C. F. Wilson, C. H. Wilson and E. L. Arthur, Wilson Concrete Co., Red Oak, Iowa; V. R. Sladek, American Steel and Wire Co., Chicago; M. W. Loving, Portland Cement Association, Chicago.

Extension of 112,500 Hp. Is Dedicated at Niagara

Additions to Station No. 3 Opened by Throwing in First of Three 32,500 Kva.-Unit Installations

In the presence of about 500 prominent guests from Buffalo and Niagara Falls, the switch which formally placed in operation the first of three 32,500-kva. generators in the new addition to the Niagara Falls Power Co.'s No. 3 station, just below the international bridge on the American side, was thrown at 2:30 p.m., Dec. 20, 1919, by J. F. Schoellkopf, chairman of the board of directors of the company. The new extension adds 112,500 hp. to the company's capacity, raising it to a total of 450,000 hp. Station No. 3 is thereby increased from an installed capacity of 130,000 hp. to 242,500 horsepower.

The new unit consists of an Allis-Chalmers 25-cycle, three-phase, 12,000-volt generator rated at 32,500 kva., driven at 150 r.p.m. by a single runner, inward discharge Allis-Chalmers water turbine operating under an effective head of 215 ft. The shaft of the water wheel, directly connected to the generator, measures 27 in. in diameter. The entire unit, from the tailrace to the top of the Kingsbury bearing in the generator housing, stands 67 ft. high. The waterwheel is connected to a penstock 15½ ft. in diameter and 350 ft. long. This penstock opens into a forebay 78 ft. wide by 160 ft. long and 28 ft. deep, fed by a canal with its intake about one-half mile above the American Falls.

Illinois Highway Officials and Contractors Discuss Plans

Materials are available for any amount of paved road whose construction is contemplated in Illinois in 1920, and car service will be ample for handling materials until about August. By getting all materials needed for the season's work into stock pile by Aug. 1, 1920, there ought not to be great delay due to materials shortage. This action will require provision for storing about 25 per cent of the season's supply. In general, these were the conclusions announced at a conference in Chicago, Ill., on Dec. 26, 1919, of officials of the Illinois Division of Highways and representatives of some fifty highway contractors.

Contractors generally will prepare to accumulate stocks during the early months of the year. Other subjects discussed included the length of contracts, time limits, wages and prices, but no definite conclusions were reached.

Chicago Hospital Bill Is Favored by House Committee

Purchase of the 320-acre site for the Speedway Hospital in Chicago is authorized in a bill reported favorably to the House of Representatives by the Committee on Public Buildings and Grounds. The uncompleted hospital building is to be finished and five auxiliary buildings are to be constructed, in accordance with the terms of the bill, but the committee declined to allow the $2,500,000 provision for additional buildings.

The House committee suggested that the Secretary of the Treasury should make a regular estimate to cover that sum, after it has been shown conclusively that additional hospital facilities will be needed by the Government.

It was recommended by the committee that the part of the plant to be immediately completed provide for 995 beds, and in addition give the Public Health Service 120,000 sq.ft. of floor space in a fire-resisting building.

Civil Service Examinations

New Jersey. Deputy chief engineer, Department of Streets and Public Improvements, $6,000 per year, Jan. 28. File applications with State Civil Service Commission at Trenton.

New York State. Assistant sanitary engineer, State Department of Health, $2,000 per year (with possible increase to $2,400), Jan. 24. Apply to State Civil Service Commission at Albany before Jan. 20. Application forms for this examination will not be sent out after Jan. 12.

New York State. Engineering assistant, Office of State Engineer and Highway Department, $1080 to $1560 per year, Jan. 24.

New York State. Engineering draftsman, $1500 to $1800 per year, Jan. 24.

New York State. Junior assistant engineer, grade 1, Office of State Engineer and Highway Department, $1620 to $1860 per year, Jan. 24.

New York State. Junior assistant engineer, grade 2, Office of State Engineer and Highway Department, $1980 to $2280 per year, Jan. 25.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Architectural and structural steel draftsman, Lighthouse Service, Key West, Fla., $1560 per year, Jan. 6. File application before Jan. 6.

Fire-prevention engineer, office of Director of Purchase and Storage, War Department, duty throughout United States, $2500 to $4000 per year, Jan. 13. Application should be filed before that date.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

BRIDGE BUILDERS' & STRUCTURAL SOCIETY, 50 Church St., New York City; Jan. 16, New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 W. 39th St., New York City; Jan. 21-22, New York City.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; 111 W. Washington St., Chicago; Jan. 21-23, Chicago.

ENGINEERING INSTITUTE OF CANADA; General Secretary, Fraser S. Keith, 176 Mansfield St., Montreal; Jan. 27-29, Montreal.

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 9-13, Louisville, Ky.

AMERICAN WOOD-PRESERVERS' ASSOCIATION; Secretary-Treasurer, F. J. Angier, Mt. Royal Station, Baltimore; Feb. 10-12, Chicago.

AMERICAN CONCRETE PIPE ASSOCIATION; 210 South La Salle St., Chicago; Feb. 20-21, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

The American Association of Engineers' second annual conference of professional engineers in railroad service will be held Mar. 15, 1920, in Chicago. The date named is the day previous to the opening of the convention of the American Railway Engineering Association.

The American Concrete Institute, through its board of direction, has appointed Harvey Whipple as secretary. The business office of the institute will be removed from Boston to Detroit; the new quarters will be at 314 New Telegraph Bldg. The board of direction announces that it has important plans for an energetic post-war renewal of activities looking to early standardization in certain design and construction practices.

A Newark, N. J., Chapter of the American Association of Engineers was recently formed, with the following officers: President, Frederic A. Reimer; vice-presidents, Robert A. Meeker and David Boswell; treasurer, John L. Vogel, and secretary, D. W. Krellurtz, West New York, N. J.

The Utica, N. Y., Engineering Society may be the name chosen for an organization of local engineers, the formation of which will be discussed at a meeting Jan. 7 at the Hotel Utica. All local technical engineers have been invited to the meeting. All interested are requested to communicate with Byron E. White, engineer, Utica Gas & Electric Company.

The Baltimore Chapter of the American Association of Engineers increased its membership about 182% during the two weeks of the recent membership campaign, and it was expected that membership in the chapter would reach 500 before the first of the year.

The Engineers and Architects' Association, Los Angeles Chapter of the American Association of Engineers, held a series of meetings in the week ending Dec. 29. They were, respectively, in charge of Carl A. Heinze, Public Service Department; J. F. Lambert, Pacific Electric Ry.; Forrest Casey, General Petroleum Co.; Frank J. Severy, Union Oil Co., and David E. Godfrey, of the State Highway Commission.

The Albany, N. Y., Society of Civil Engineers elected the following officers at the annual meeting Dec. 23: President, Frank H. Macy; vice-presidents, Emory E. Brandow, J. P. Graham and Thomas L. Watkins; secretary-treasurer, John W. Henry; librarian, John W. Carpenter.

The Engineers' Club of the Youngstown, Ohio, District held a regular monthly meeting Dec. 30, at which F. W. Funk, president of the club, presented a paper on "Improved Electric Transit in Youngstown and Interurban Vicinity."

PERSONAL NOTES

LIEUT. COL. D. H. SAWYER has become associated with James Stewart & Co., and will have charge as manager of the work of that company in Detroit and vicinity. Colonel Sawyer was constructing quartermaster in charge of the construction of Camp Grant, and constructing quartermaster of the nitrate plant at Cincinnati and the artillery cantonment at Fayetteville, N. C. Previous to the war he maintained, with his brothers, consulting offices for general engineering work in Spokane and Seattle.

M. C. BYERS, vice-president and general manager, Western Maryland Ry., and previously assistant to the president, is to become the operating head of the road when it is returned to private control, according to recent announcement. Mr. Byers was successively chief engineer of operation of the St. Louis & San Francisco R.R. and assistant to the president of the Great Northern.

CLARENCE H. FAY has been appointed commissioner of public works, Borough of Manhattan, New York City.

E. H. BALDWIN, previously assistant construction engineer, Guggenheim Bros., with supervision of construction work in South America, has been appointed chief construction engineer, Sinclair Refining Co., with headquarters in Chicago. He served 10 years with the Metropolitan Water and Sewerage Board of Massachusetts as assistant engineer and division engineer, followed by 12 years with the United States Reclamation Service as construction and supervising engineer and acting chief engineer of construction. He left the Reclamation Service in 1917 to go to South America for Guggenheim Brothers.

EDWARD B. LEWIS, formerly structural engineer, TOLTZ, KING & DAY, INC., St. Paul, has become associated with Clyde W. Smith, architect, in the general practice of architecture and engineering, with offices in the Andrus Bldg., Minneapolis.

PAUL D. PRATT, M. F. CURRAN, and L. C. BEATTIE have formed the STATE ENGINEERING & CONSTRUCTION Co., engineers and contractors, with headquarters at Helena, Mont.

WILLIAM W. PEARSE, since 1914 city architect and superintendent of buildings for Toronto, Ont., has resigned to become business manager of the Toronto Board of Education.

J. J. COLLINS, W. D. HAMMOND and LINTON HART, formerly of the Raymond Concrete Pile Co. and the Dock Contractor Co., have formed the Rollin Construction Corporation, to engage in general construction, with offices at 90 West St., New York City, and 80 Boylston St., Boston.

R. M. MORTON, formerly engineer of the Sacramento County, California, Highway Commission, has resigned to become chief engineer of the San Diego County Highway Commission, taking office Jan. 1, 1920.

CHARLES J. KALTENBACH has resigned as bridge engineer, West Virginia State Road Commission, to enter industrial work in Pittsburgh.

E. W. MCCOY and J. E. HAMMOND have opened offices in the Brunson Bldg., Columbus, Ohio, to engage in private practice.

C. A. ROTHROCK, former county road engineer, Morgan County, West Virginia, has joined the staff of the Portland Cement Association, with state headquarters at Parkersburg. Mr. Rothrock previously served as maintenance engineer, Los Angeles, Cal., County Highway Association.

OBITUARY

FRANCIS H. KIMBALL, architect of many of the large buildings in New York, died in that city Dec. 25, at the age of 74. In 1867 he entered the office of Gridley J. F. Bryant and Louis P. Rogers, architects, Boston, and afterward took charge of their Hartford office. From that time he was engaged continuously in architectural and structural work. He went to New York in 1879, and later designed several theater buildings, among other work. In 1893 he joined forces with C. K. Thompson to erect the Manhattan Life Bldg. in New York. Among the buildings which he designed

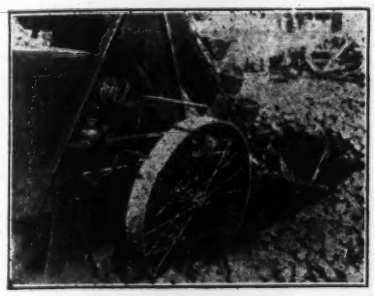
at the Garrick, the Casino and Fifth Avenue Theaters, the United States Realty, Adams Express, City Investing, Empire, Trinity and Manhattan Life Buildings, all in New York City.

JAMES MALONE, who had served for many years as an engineer in the Department of Water-Supply, Gas and Electricity of New York City, died Dec. 23, 1919, in Brooklyn. He retired five years ago.

GEORGE A. LITTLE, superintendent of streets, Ottawa, Ont., died in that city Dec. 17, 1919, at the age of 61.

Self-Feeding Loader Handles Heavy Material

A self-feeding and self-propelling wagon loader, at the plant of the United States Cast-Iron Pipe & Foundry Co., Burlington, N. J., is reported to be doing the heaviest work a loader of this general type has ever performed. The material loaded is brick and debris from a cupola which the



SELF-FEEDING LOADER DIGS PATH THROUGH HEAVY MATERIAL

company has demolished. The accompanying illustration shows the size of the material handled, with the paddles of the loader digging a path and clearing the material away from the wheels so that the machine may be propelled forward by its own power.

The loader is equipped with a swivel spout, instead of a chute, that is designed to swing to 180 deg., so that material can be discharged on either side of the machine as well as in front.

The loader was manufactured by the George Haiss Manufacturing Co., Inc., New York City.

BUSINESS NOTES

THE NEW YORK CONTINENTAL JEWELL FILTRATION CO. of Nutley, N. J., announces the appointment of Arthur M. Crane, formerly general sales manager, as general manager of the company, succeeding the late Robert E. Milligan. D. C. Williamson continues as chief engineer and E. K. Sorenson as secretary and assistant treasurer.

THE WALDO BROS. & BOND CO., Boston, has been formed through the consolidation of Waldo Bros., Inc., building materials, and the Harold L. Bond Co., construction equipment, both of Boston. The Waldo firm was established in 1869, and the Bond Co. in 1900. The officers and directors of the company are: President, Harold L. Bond; first vice-president, C. Sidney Waldo; vice-president, Llewellyn Howland; secretary, Harold C. Bond; sales manager, Frederic W. Mattheis; treasurer, James G. Lincoln. Other directors are Roger Ernst and Frank M. Bates. The offices and salesroom of the new company are at 181 Congress street.

THE READING IRON CO., has acquired the plant of the E. & G. Brooke Iron Co., Birdsboro, Pa., adding 16 double puddling furnaces to the existing equipment of the Reading company.

THE WESTINGHOUSE AIR BRAKE CO., Wilmerding, Pa., has created an export department, in charge of E. A. Craig. The department will be represented in the New York office by W. G. Kaylor and in South America by R. M. Oates.

THE TACONY STEEL CO., Cleveland, announces that A. E. De Clercq has joined its Cleveland sales force.

THE ECONOMY HOIST & BODY CO., INC., 405 Lexington Ave., New York City, will succeed the Economy Body Sales Co., under the same management, with A. W. Herbst as general manager and C. C. J. Culmer as sales manager.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, announces that the Atlas Machinery & Supply Co. is now handling the sale of the "American" steam ash conveyor in the St. Louis territory. The Atlas company is headed by William H. Patton, with offices at 1416 Syndicate Trust Bldg., St. Louis.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE MILWAUKEE AIR POWER PUMP CO., 886 Third St., Milwaukee, Wis.; pamphlets, 6 x 9 in., 4 to 30 pages, illustrated; all dealing with water systems for institutions, country clubs and homes, schools, farms and other places not served by city water systems. Small electric-light plants and septic tanks for sewage disposal are also described.

THE CITY IRON WORKS, Portland, Ore.; structural-steel and ornamental-iron work manual with tables of sizes, weights, etc., of metal work of the company's manufacture.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis.; bulletins Nos. 1411 and 1454, 8 x 10½ in., illustrated, 15 and 45 pages, respectively; bulletin No. 1411 gives the specifications of details of modern rock-crushing plant, and bulletin No. 1454 explains the operative principles of the Allis-Chalmers dust collector.

THE WARNER ELEVATOR MANUFACTURING CO., Cincinnati, Ohio; bulletin, 9 x 12 in., illustrated, 12 pages; descriptive matter on motors, cages, etc.

THE AMERICAN CEMENT MACHINE CO., INC., Keokuk, Iowa; catalog No. 920, 8½ x 11 in., 63 pages, illustrated, describing "'Boss' Labor-Saving Construction Machinery." It contains descriptions of various forms of contractors' concrete machinery and equipment, with illustrations of their use.

The Outlook for Construction in 1920

A Serious Shortage of Materials—Prices the Tangible But Not the Determining Factor in This Year's Work

BY ALDEN W. WELCH
Of the Business News Department, McGraw-Hill Company

The present remarkable condition of the material market is not the work of any one cause. The steel strike, the coal shortage, the high prices and, finally, the unprecedented autumn volume of construction work, are the important factors that have produced a shortage in certain lines of building materials.

Last spring we were deploring the lethargy in the construction field; everything, except high prices and false prophets, urged tremendous activity. The country was years underbuilt. Nearly every state and municipality cried for repair and enlargement of public works, while the housing problem was every bit as acute as it is today. In spite of this, capital, suffering from an excess of caution, held back, waiting for conditions to "stabilize." With exasperating deliberation, work got under way, until now—even in this winter season—the demand for materials in many cases exceeds the supply.

DEMAND

Some idea of the demand may be had by a comparison of the value of contracts being awarded at the present time and in similar periods of 1918 (an unusually dull year) and in 1913 (a normal year). Such a study will show that the present requisition on construction materials is quite unusual, in spite of the reduced purchasing power of the dollar.

The one tangible factor that held back construction and ultimately caused the present jam was the high level of prices. There is no denying that prices were high and are now still higher, but, whereas a year ago capi-

tal was demanding a radical reduction, capital now acknowledges that high prices are here to stay—for a few years, at least. What was called abnormal last January is now accepted as normal. In fact, there is a strong feeling—already substantiated in certain lines—that prices will be still higher next spring.

Prices

What are the facts on prices? The quotations published monthly in *Engineering News-Record* furnish full and trustworthy data for study.

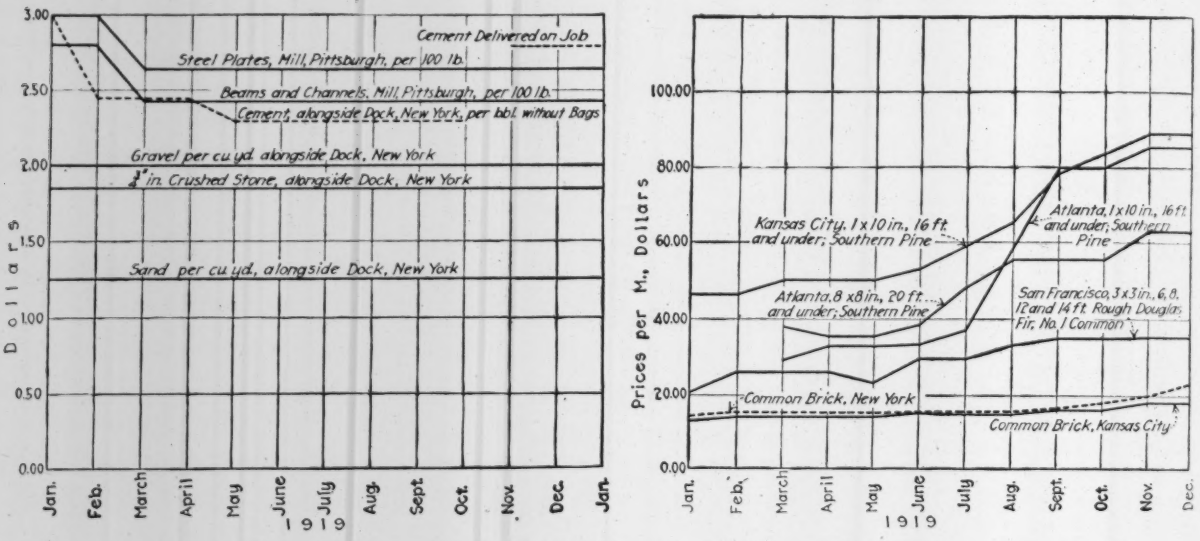
Basic construction materials divide into two classes, as regards price tendencies in 1919. One group, including steel and concreting materials, has remained practically stationary in the mills are on full production. Even so, it is equally conceivable that steel prices will advance about that time.

In the case of cement, stocks over the country are relatively light, owing to the small demand during the first half of 1919 and the heavy ordering in the last six months. Prices have fluctuated but little, but a general increase in the spring would not be surprising. Already two companies have advanced their price 25c. per barrel.

Prices of sand and gravel remain practically as they were a year ago, but it is significant that in important instances an advance of 25c. per cubic yard is asked for spring deliveries. New York men in this line state that seven years' work has piled up and that a booming 1920 is anticipated, with vest in what seemed inflated valu today the situation is reversed.

Far from subsiding, the vitality today will probably be compounded the spring, which promises to be liveliest construction period in the h tory of the country. It would se inevitable that prices should stiffen.

As a final argument, consider wage Indicative is the recent agreement entered into between the Building Trade Employers' Association and the Build ing Trades Council, of New York, which reads: "In order to secure continuity of employment and uninterrupted production . . . . the working week shall consist of 44 hours; the rates of wages from Jan. 1, 1920, to Dec. 31, 1921, shall be as follows: Carpenters, $8 per day; dock builders.


Cement Delivered on Job
Steel Plates, Mill, Pittsburgh, per 100 lb.
Beams and Channels, Mill, Pittsburgh, per 100 lb.
Cement, alongside Dock, New York, per bbl. without Bags
Gravel per cu. yd. alongside Dock, New York
¾" in. Crushed Stone, alongside Dock, New York
Sand per cu. yd., alongside Dock, New York
Dollars
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec. Jan.
1919
Prices per M., Dollars
100.00
80.00
60.00
40.00
20.00
0.00
Kansas City, 1 x 10 in., 16 ft. and under; Southern Pine
Atlanta, 1 x 10 in., 16 ft. and under; Southern Pine
Atlanta, 8 x 8 in., 20 ft. and under; Southern Pine
San Francisco, 3 x 3 in., 6, 8, 12 and 14 ft. Rough Douglas Fir, No. 1 Common
Common Brick, New York
Common Brick, Kansas City
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec.
1919

PRICE TREND DIVIDES CONSTRUCTION MATERIALS INTO TWO GROUPS HAVING WIDELY DIFFERENT CHARACTERISTICS

quoted price; the other group, of which lumber and brick are the features, has advanced rapidly to unheard-of levels. The situation is graphically portrayed by the two charts.

The first set of curves is particularly remarkable for the steadiness with which prices of certain building materials have held during the year. Since last March there has been absolutely no fluctuation in prices of steel plates, structurals, cement, sand, gravel or crushed stone. Of course, during the past few months this steadiness has meant little to construction progress, owing to decreased production occasioned by strikes. Not only have the mills, in many instances, withdrawn quotations, but warehouse stocks have been seriously depleted as well. A shortage of railroad cars has aggravated the situation. It is almost impossible to obtain certain gages of steel sheets, and reinforcing steel is held at a premium. Consequently, it must be distinctly understood that the quoted steel prices have little meaning just at present. This speculative element, however, will endure only until the labor difficulties have been adjusted and plenty of stock to supply the demand, however great the latter may be. With crushed stone the situation is much the same. In New York the official price is $1.85 per cubic yard; but 25c. more could easily be obtained for spring deliveries. Poor transportation facilities have seriously interfered with stone and gravel deliveries on highway work, and have thus thrown a heavy demand over into 1920.

As regards the second group of essential construction materials, a glance at the right-hand set of curves will indicate what has happened. In the case of lumber, heavy demand has made it possible to inflate the market. The effect of these lumber prices is far-reaching. It means a curtailment of the use of lumber and a turning, where possible, to steel and concrete on the part of former lumber users. The brick market is of a local nature, but in certain centers—notably New York and St. Louis—the prices are extremely high.

Conclusion

To sum up, the high prices of a year ago are in no case lower today. Half a year ago capital was reluctant to in-

house shorers and sheet pilers, $7.50; composition roofers and waterproofers, $7.50; granite cutters, $8; hoisting engineers, $9; metallic lathers, roofers, painters, sheet-metal workers and tile layers, $8; plasterers, $8.50. . . . . Provided, should the cost of living materially change . . . . the wage schedule for 1921 shall be reopened and readjusted." It is further agreed that "the unions as a whole or as a single union shall not order any strike . . . . nor shall any member of the Building Trades Employers' Association lock out his employees." Finally, "the unions agree to furnish at all times sufficient men to man the work of the association."

This means that New York contractors and their men are ready to handle the expected spring rush, and it is believed that this is the attitude generally throughout the country. There are many indications that engineering and construction stand on the threshold of a big year. The country is so far underbuilt that prices have become subsidiary to necessity. Construction must go forward even in the event of a slightly rising market.